The Journal
of the
Mysore Agricultural
and
Experimental Union

Vol. XII. 1931. No. 4

IN MEMORIAM

DR. K. KUNHI KANNAN, M.A., Ph.D.

BORN 15TH OCTOBER 1884—DIED 4TH AUGUST 1931.

Of late the hand of death has been heavy on our Department and we have to mourn the loss of yet another officer. It is this time Dr. K. Kunhi Kannan, the popular and brilliant Entomologist of the Department, who has been snatched away from us in the prime of his life, stricken like a soldier in the field of battle, in the thick of his strenuous and beneficent activities both in the Department and outside. He passed away indeed so suddenly that the sad news was hardly believed even by his close and everyday associates. I little dreamt that it would fall to my lot to assist in the mournful duties of his last rites, or to dip my pen in sorrow and pain and write these few lines of an all too imperfect appreciation of his work and character. Such as it is, however, let me pay my sorrowful homage to the memory of our departed friend and place on his grave this wreath of flowers gathered and blessed by the loving hands of his friends and colleagues.

The late Dr. Kunhi Kannan joined the Department in November 1908 after a brilliant college career which culminated in his taking the degree of Master of Arts of the Madras University. He was a man of outstanding merit even at that time and was specially selected by Dr. Leslie C. Coleman who was then Entomologist and Mycologist, as his assistant, almost immediately after the entomological section was created. He was therefore connected with the entomological work of the Department from its very inception. As Dr. Coleman's only assistant at that time and later as his chief assistant he plunged straight into the work of practical insect control, and had a most strenuous time both in the laboratory and out in the districts where the campaigns used to last for months on end in the midst of hardships which in these days of motor transport are practically unknown. He always looked back to this period of hard training as one of his invaluable assets and responsible for much of his later successes. Twelve years later he was selected by Government to undergo foreign training; he selected the Stanford University in California for his advanced studies, whence eventually he took the degree of Ph.D. During the period of his foreign travel, he visited many important centres of entomological work, in Egypt, Great Britain, the U.S.A., the Hawaiian Islands and Japan. After his return he was raised in due course to the responsible position of Entomologist to the Department in July 1923. It was thus on a remarkably strong and broad foundation that Dr. Kunhi Kannan's work in the Department was based and on his part it was inspired by the driving force of an overmastering desire to do and achieve.

As is the distinguishing feature of all the work of the Department, his work related to problems of immediate practical importance, the studying and carrying out of control methods of the main crop pests of the State. Much of his work has been published in the various bulletins and

other publications of the Department and elsewhere, which all betoken his thoroughness and painstaking accuracy and have earned the approbation of men competent to judge. A most notable feature of his work and one of his chief claims to the gratitude of the ryot is the manner in which he broke away from the thraldom of the spray pump, the duster and other mechanical tackle and concentrated on simple and inexpensive methods of pest control, never spurning to dip into the traditional lore of the ryot. His recommendations relating to the control of the *Kumblihula* pest, the coffee stem borer, the sugarcane moth borer, the lime tree borer, the rice case-worm, the *avare* pod borer and the beetles attacking stored pulses, all illustrate this feature of his work admirably. His latest work related to the insecticidal properties of the leaves of the *Mundulia suberosa* with special reference to its effect on the mosquito larvæ and all that it implies for malaria control. Arising out of this subject, a scheme for a comprehensive study of all the different indigenous materials used as fish poisons in the country in respect of their insecticidal properties, was put forward by him, which promises to become a very fruitful line of inquiry. The introduction of the cactus insect from Australia and the energetic manner in which he pushed the work forward have certainly earned for him the gratitude of the ryot and his cattle, for, from the village outskirts and the grazing grounds, the cactus is rapidly disappearing, thanks to his efforts. It is doubly and most painfully tragic that his death should have occurred at a time when facilities and opportunities have been greatly enlarged, which would have afforded scope for the exercise of his wide knowledge and ripe expericnce to the lasting benefit of Mysore agriculture. Nor did Dr. Kunhi Kannan, in the midst of all this work on strictly agricultural entomology, neglect his love for pure science; it may not generally be known that for some years past, he was testing out elaborately, an original theory of his own on the

so-called "protective" mimicry in the animal kingdom and was looking forward to somewhat startling results.

Dr. Kunhi Kannan had much wider interests than those of the official entomologist that he was, which he pursued assiduously. He was a typical representative of the class described as the modern intelligentia of this country, with all its aspirations and enthusiasms. A brilliant product of the University, he was a man of culture to his finger tips. Wide reading embracing not only *belles lettres* but subjects of a serious character as well, with a decided *penchant* for ancient Indian civilization, especially on its artistic side, and a mind widened and enriched by extensive travel, enabled him to captivate whoever came in contact with him with his charming and intelligent conversation. He had a remarkable command of the English language both as a speaker and as a writer and in his lighter moments he attempted not a little versifying, which the leading lights of the Department whom he pilloried in good humoured doggerel have cause to remember. In his outlook he was passionately national, no narrow prejudices marred his views or tainted his springs of action. His sympathies were patently genuine and he was not slow to demonstrate them in a practical manner. Amongst the institutions which thus claimed his loving and practical interest were the National High School in Bangalore and the Asram in Kengeri. He had withal a forceful personality with strong views which he seldom hesitated to press with a directness and vehemence which, though sometimes disconcerting, were always helpful.

In the midst of his busy duties, Dr. Kunhi Kannan found time for literary labour and wrote two notable works, one of which "The West" was published a few years ago. It is the Indian eye on the life and institutions of the West and should Uncle Sam or John Bull feel like the poet at any time a yearning for the "giftic to see ourselves as ithers see us", few books can hold up the mirror to them so

helpfully as the candid pages of "The West". Its companion volume was going through the press at the time of his passing away. In recent years too, Dr. Kunhi Kannan was strongly attracted to the subject of rural reconstruction. He developed a practical working scheme of his own, which met with cordial support from very high quarters and which he was pursuing with his wonted pertinacity, but he passed away before it could be brought to fruition.

And all this time, alas, poor Dr. Kunhi Kannan was in the grip of a terrible type of asthma, a disease which sat on him like a blight throughout. He bore his cross, however, with a manliness and fortitude truly astonishing. He never let this serious infirmity to interfere with his arduous duties and self-imposed tasks, and only those who have watched him in his district work in the earlier years can realize what a slow martyrdom he was suffering.

Simple and unassuming and with a kindly and pleasing personality he was a devoted friend and delightful companion ; and many have been the times when he proved a tower of strength to those about him. In him the Department loses truly one of its pillars ; his large circle of friends its centre and pivot, and the country one of its most talented sons. May his soul rest in peace !

A. K. YEGNANARAYANA IYER.

Co-operative Cotton Sale Societies in Dharwar, Bombay Presidency.

BY

A. K. Yegnanarayana Iyer, M.A., Dip. in Agri. (Cantab.), N.D.D.,

Deputy Director of Agriculture in Mysore.

During the last cotton sale season I visited the Co-operative Cotton Sale Societies of Hubli and Gadag, to study their organization and methods of work with a view, if possible, to adopting similar methods in our own State. These societies have been pronounced to be the most successful examples of the co-operative marketing

of cotton and their methods of work cannot fail to be of great interest, even if they may not be applicable everywhere. The salient facts gathered during the visit are given in the following pages together with a brief account of what has been attempted here.

These Co-operative Cotton Sale Societies are all very old institutions and have been in existence now for over fifteen years. They arose from small beginnings and in the earlier years they met with strong and bitter opposition from the wealthy and powerful local cotton dealers, which took the form of an organized boycott and threatened to completely extinguish them. The societies, however, successfully weathered this storm and are now thoroughly well established institutions and have grown to very large proportions. Their present magnitude may be judged from the fact that the sale society of Hubli sold cotton in the year 1929-30, the last year for which published reports are available, to the value of nearly nine lakhs of rupees, and the sale society of Gadag to the value of about Rs. 15 lakhs. Both the societies own large sale yards of some acres in extent and enclosed by compound walls; they have their covered godowns, proportionate in size and number, to house cotton and store seed, as the sale of high grade seed forms one of their main additional functions; the Gadag Society has, in addition, part ownership of a gin which adjoins and practically forms part of its premises, a very useful arrangement in view of the society's seed business. The society's property in these forms is valued at Rs. 50,000.

These sale societies had their origin in the desire and endeavour on the part of the Agricultural Department to push on the cultivation of the improved varieties of cotton which they were introducing, for which purpose they organized a system of auction sales of these particular kinds and grades of cotton. Growers of these varieties were induced to bring their cotton pure to these centres to which the more important buyers who value purity and quality in cotton were expected to resort and pay prices substantially in excess of the prices of ordinary cotton. Through the incentive of such higher prices, the area under these new varieties was expected to expand automatically. By this arrangement the department secured at the same time an efficient method of supplying large quantities of pure seed of the varieties. This particular object and the close alliance it implies with the Agricultural Department constitute a

special feature of the movement. The societies have not been started with the object of merely trading in cotton of whatever kind it may be, the element of co-operation coming in merely in the association of growers to effect the joint sale of their produce. The sole or main aim has not been the elimination of the middleman and the diversion of his profits to the pockets of the growers themselves, such as an ordinary co-operative sale society implies, which naturally arouses antagonism and in the event of a society at all likely to succeed, drives dealers to organize and fight in self-defence. From the beginning these societies have engaged themselves in work of a specialized character, some line of work which was not being done by the ordinary dealers in the market and which perhaps one cannot expect them to take up either. Even under such conditions dealers saw in them a powerful potential rival, withheld their sympathies in the beginning and later, when the societies developed, became actively hostile as related already. Still, it is well to emphasize this special kind of work of these societies which lifts them out of the category of a mere trading concern ; in that feature, I think they find their chief strength, if not their entire *raison d'etre* and justification. Thus the Hubli Society handles only the Kumpta strains of cotton and even there, only the produce of the improved strains put out and recommended by the Agricultural Department. The Gadag Society similarly handles only the improved strain of upland cotton (Doddahatti or Dharwar-American). Both societies grade their cotton into different classes before they offer them for sale. Both the societies again arrange for retaining the seed from the best of these grades and later on to distribute the seed on a large scale. This branch of their work, *viz.*, seed distribution, they were said to carry on in spite of the fact that it is not quite looked upon with approval by the Co-operaive Department, from a business point of view. Both societies again work in close co-operation with the Agricultural Department.

Though a strictly co-operative sale society would confine its membership to the actual growers of cotton and ordinarily handle only the cotton of its own members, neither of these is strictly observed in these two societies. Not all members of the society are growers of cotton, nor is the business confined to the sale of members' cotton alone. It was stated that this was necessitated by the

force of circumstances in the initial stages but that it was gradually changing and giving place to a system more in accordance with co-operative principles. In fact the Gadag Society has recently altered its bye-laws and excluded non-agriculturists completely from membership. The membership fee is very low, *viz.*, Re. 1 per share and a member has to hold five shares ; many a grower who brought his cotton for sale through the society, as a non-member, in order to derive the advantage of the auction sale, generally became a member thereafter. In addition to individuals, a number of village co-operative credit societies are also members of the sale societies. The share capital is surprisingly small, the business being financed by deposits and loans from the Central Co-operative Banks. Thus the share capital of the Hubli Society is only about Rs. 18,000 and that of the Gadag Society Rs. 50,000. The present reserve fund of the former exceeds its share capital and that of the latter is nearly equal to its share capital. The two societies are merely sale societies and do not do any banking business in the ordinary sense. They have however to advance very large sums of money as part payment for the cotton that may be brought to them for sale, on which the grower may desire an advance pending the sale of his cotton and final settlement of his accounts. The Central Co-operative Bank comes to the assistance of the societies here and advances very large sums to them. With this financial help, the societies are enabled to advance the desired amount to the growers ; such advances are made up to 60 per cent of the approximate value of the cotton supplied. Necessary safeguards are provided in the event of the sale price falling below the advances thus made.

It was said, moreover, to be the practice for cotton dealers to issue loans at the beginning of the crop season to growers with the stipulation that such growers will market their cotton only through the particular creditor merchant. The practice was said to be all but universal here, so much so that if a merchant did not advance such loans, he practically went without any custom. These two sale societies have nevertheless steered clear of this necessity and they have been enabled to do so by the fact that a large part of their clientele are members of some village credit society or other, and that these societies issue what is called crop loans to members up to a limit of Rs. 750 per member but which usually does not exceed Rs. 300.

These loans are either in cash or in the shape of cotton seeds and gunny bags. The cash loan to the credit societies is made by the Central Banks through the sale society. These loans carry with them the obligation on the part of the member to market his cotton only through the sale societies. This sort of linking up the sale society with the credit society has been found mutually advantageous, the credit society having some guarantee of repayment out of the sale proceeds or produce advance paid by the sale society on the one hand and the latter itself securing custom without the need of its having to issue loans to members and thereby to take up the burden of banking as well.

We shall now turn to the actual handling of the cotton in the societies' premises. At every step the society takes care to see that only cotton of the desired kind is brought in for the auction. Growers usually bring with them and present at the weighing yard the receipts and bills issued by seed depot keepers in token of their cotton being of the improved strain of the Department which alone the society auctions or they give their names and addresses which can be checked from the seed supply registers or give other proof of their cotton being the produce of such seed. The cotton is also further examined by the receiving staff. As already mentioned, the Hubli Society deals in Kumpta cotton and the latest improved strain of this variety put out by the Department called "Jaiwant"; the cotton brought in has to conform to this quality. The Gadag Society deals in Upland and the cotton is brought in as that raised from third, fourth, fifth or sixth generation seed. As seed is all distributed under the control of the society it is found to be possible to classify the cotton so elaborately. It was a bit of a mild surprise to me to see ryots calling their cotton by these out-landish names of this or that generation, showing how the Department and the society had made these familiar. The third generation is really seed issued from the Departmental seed farms and comparatively small in extent but with every subsequent generation the area broadens wider and wider with the quality naturally falling in proportion.

All cotton arrives in *andigis* or *docras* packed in rather open sacking. The weighing is done immediately after and in the presence of the client. The rate to be allowed for the sacking is according to a fixed schedule, but in cases (perhaps exceptional) where the

consignment may have been exposed to rain in transit, the necessary increase in the tare is a matter of judgment left to the weighing authority, but seemed to be acquiesced in by the grower though not without demur. On each *andigi* or *docra* weighing 13 maunds, a deduction of 14 lbs. is made as tare and for every maund extra of the *docra* an additional 2 lbs. are deducted. In the Dharwar Society an additional 2 lbs. for driage and 1 lb. for errors in weighing are also deducted per *docra*. A further 2 lbs. per *docra* is also deducted as sample which however goes to the buyer.

The societies sell cotton both by auction sale and by private sale, as the grower may desire and also as the quality may warrant. The auction sale lots are handled and dealt with separately from the private sale lots. In the case of these latter, only the tare per *docra* is deducted. In the case of lots which the grower desires to be included in the auction sale, some further deductions are also made such as for driage, sample and errors or inequalities in weighment according to the rates mentioned above. In either case the grower is given, immediately after weighment of his cotton, a receipt for the net weight credited to him. If the grower requires immediate payment on account, then he presents the receipt at the Society's office and can receive an advance up to 60 per cent of the approximate value of his cotton; he however pays interest on the sum at the rate of 9 per cent.

In the case of the auction sale lots, the cotton is all graded. Out of every *docra* of each grower's supply a sample is taken and any number of his *docras* not exceeding ten is treated as one lot and the samples from these are mixed. Each of these lots is separately ginned and the ginning percentage noted. In the Hubli auction of "Jaiwant" cotton, only two grades are recognized, class I consisting of cotton with a ginning percentage of 26 and upwards, and class II, between 24 and 26. Lots which gin lower than this are not included in the auction sale. Prior to the auction sale which is well advertised in advance, the number of *docras* available in each grade is notified and on the day of the auction sale, the society announces also the price at which it will buy the seed of class I on the strength of which information, buyers bid. The *docras* selected for the society's seed purchase are now ginned pure and clean under proper supervision and the seed stocked for sale in due course.

The Gadag Society's grading is rather elaborate; this society classes the auction lots in as many as five grades taking both ginning percentage and cleanliness into consideration. The method of sampling is about the same as in Hubli. Each *docra* is opened and inspected and those showing mixtures or are otherwise obviously below quality are rejected. Each of the other *docras* is then classified according to cleanliness and ginning percentage, the requisite sample of 25 tolas being taken from each. The scheme of classification is represented in the following chart. As regards ginning percentage the classes are the following:—(1) 34 and above, (2) 33.9 to 33, (3) 32.9 to 32.1, (4) 32 to 31.6 and (5) 31.5 to 31, those below being rejected, and as regards cleanliness the classes are:—A-1, A-2, B-1, B-2, and C in descending order. These two factors are combined and the grades fixed as Special A, Special I, II, and III as shown below:—

Gadag Society's Grading Scheme for Uplands.

Cleanliness	34 and above.	Ginning Percentage				
		33.9 to 33	32.9 to 32.1	32 to 31.6	31.5 to 31	Below 31 Reject
A—1 ..	Sp. A	Sp. A	Sp.	I	II	
A—2 ..	Sp. A	Sp.	I	II	III	
B—1 ..	Sp.	I	II	III	Reject	
B—2 ..	I	II	III	Reject	Reject	
C ..	II	III	Reject	Reject	Reject	

The grading of the cotton is entirely in the hands of the staff of the Agricultural Department trained and deputed to the societies for this work. Prior to the auction sale here too, the number of *docras* available in each class is notified as well as the price at which seeds of selected *docras* will be purchased. Auction sales are arranged practically once a fortnight and soon after each auction sale the prices realized for each grade are published as well as the date of the next auction through handbills. Of course, the information regarding prices realized gives nobody an idea of the prices likely to prevail at the following auction and growers trust to their luck in the matter of the prices that may be obtained at the auction sale to which they may bring their cotton. It may, and sometimes does, happen

that a private merchant is able to pay higher prices than the market price at the time, the reason being that he may have forward contracts to fulfil at higher prices and may not hesitate to cut his margin somewhat if thereby he can attract custom : but obviously this is only in the nature of a bait and can apply only to comparatively small quantities, negligible in a market of this magnitude.

The society's auctions are well advertised and auctions are attended by representatives of all the large mills so that there is a keen competition and the advantage such competition affords in respect of enhanced prices. The details of one such auction sale at Gadag held on the 20th March 1931, regarding classification, number of *docras* put up, and names of buyers are given in the Appendix to give an idea of the auction sale. The terms and conditions of the sale are also appended.

As may have been gathered, things have not always been so bright ; at one time the dealers' combine and boycott was so severe that the auctions attracted almost no buyers. It was mentioned that the Tata Mills represented by Mr. Belgaumvala in Hubli stood steadfastly by the society during those critical years, and thereby broke the strength of the boycott and paved the way for a settlement such as has prevailed since.

The charges levied by the sale societies on the cotton sold by them either by open auction sale or by private negotiation are the following :—

1. Commission.
2. Hamali, *i.e.*, porterage or yard coolies.
3. Nitte Majuri (Stacking cooli).
4. Insurance.
5. Godown rent.
6. Baradana.
7. Pinjrapole.

It will be seen that every one of these items is quite a legitimate charge except item No. 7. The whole of these together amount to only 3 per cent on the total price realized which can hardly be considered at all high. One client's account is appended as sample :—

ACCOUNT A.

	Credit.	Debit.
	Rs. A. P.	Rs. A. P.
98 maunds of cotton	285 5 0	....
Commission	....	2 0 9
Hamali	....	0 14 0
Nitte majuri	....	0 8 0
Insurance	....	4 0 0
Godown rent	....	1 0 0
Baradana	....	0 3 3
Pinjrapole	....	0 4 0
Total		8 10 0

Total debit about 3 per cent.

The societies further levy commission from the buyers at the rate of Re. 1 per *naga* (48 mds. of 28 lbs.) on kappas and annas 12 as per *naga* of lint, for private sale and at Rs. 1-4-0 and Re. 1-0-0 respectively on lots put up for auction sale. The income to the societies from commission is therefore Rs. 2-4-0 per *naga* of kappas and Rs. 1-12-0 per *naga* of lint of all cotton put up for auction.

The full details of the charge levied both from sellers and buyers are given in the Appendix.

It may be added that excepting insurance charges the other items are said to be the same in the local *dalals* (Brokers) also: insurance of cotton not being customary with the latter.

In our own cotton markets of Davangere and Chitaldrug also the charges levied comprise more or less the same items, with the addition of a small contribution to the *Mutt* called "Pakki". The rate of commission is however, higher, being Rs. 2 on every Rs. 100.

Even in the case of the total charges levied by the *dalals*, whether in Hubli or in our own cotton markets, the percentage to prices realized cannot be called excessive, and much of the outcry against these charges will disappear if, instead of itemizing them in the debit note, any lumpsum charge is put down which may include the commission as well as the other charges. As a matter of fact with the exception of the amount put down as charity, cow protection fund, pinjrapole and the like, the others are all for service rendered, for

materials expended, or for the use of godown, yards, balances, etc. If there is any truth in the allegations usually made that the merchant does the ryot in the eye, it is certainly not through these charges which are by no means exorbitant : the fraud, if any, must be looked for elsewhere in the chain of transactions : it certainly cannot lie on the surface, like the entries in a receipt. But whatever truth there may be in this allegation and whatever may be the magnitude of such practices in terms of loss to the ryot, the growing popularity of these co-operative sale societies affords convincing proof of the ryots' preference for such institutions as against the ordinary dealers' shops and therefore in his belief in the existence of such practices. Thus the Hubli Society is already handling a sixth of the total crop in the market in the face of a score or more of large merchants competing for custom and it was said that the proportion is likely to increase. The same is true in a large measure of the other societies also.

We may now refer to the way in which the sale societies help in the distribution of the seeds of the improved strains of cotton evolved and multiplied by the Agricultural Department which has already been touched upon briefly. The seed from the selected cotton is ginned and stocked by the sale society and later is sold through up-country co-operative societies and special seed depots. The Gadag Society had twenty such seed depots in the season 1929-30 and sold 7,33,174 lbs. of seed through them. The Sale Society pays, further, all transport charges, a commission or salary for the depot keeper and incurs all incidental charges. Seed is sold at reasonable rates even though below cost price. Sometimes an unsold surplus remains at the end of the season which has to be sold as cattle feed at a low price. Such surplus stock of seed during the same season amounted to 9,54,403 lbs. in the case of the Gadag Society or almost 60 per cent of the total quantity of seed stocked. All these entail considerable losses and, as a matter of fact, these losses cut into and reduce the profits of the society accruing from the cotton sale side of the business. Latterly, however, the Indian Central Cotton Committee has come to their assistance and is meeting a good portion of these items of expenditure in addition to paying the salary of four graduate assistants and five fieldmen belonging to the Agricultural Department who are told off for work under the societies. A

steady supply of pure seed is derived from special controlled areas growing departmental seed. The crops on these areas are all inspected by the staff and mixtures are rogued out. Such areas constitute really Seed Farms and are called "Reserved Areas". The extent of these seed farms last year is reported to have been 12,000 acres which is to be increased to 23,000 acres in the current season. With a controlled supply of good seed from a central source like the societies and with the Cotton Transport Act to assist in keeping out import of other seed into these areas, it is believed that all mixtures will diminish to a vanishing point in the course of a few more seasons and the huge market supplied with cotton of one and the same strain. Such an arrangement will also facilitate the introduction into cultivation of other and further improved strains such as the cotton breeder may evolve every now and then.

As regards the possibilities of starting similar sale societies in our State the situation as compared with that tract is this. In the first place ours is a very limited cotton area, the total acreage itself is only about 90,000 acres and this area is scattered over several districts, the principal areas being as under :—

Chitaldrug District	..	68,000 acres (in round numbers).
Shimoga District	..	7,500 ,,
Tumkur District	..	7,200 ,,
Mysore District	..	2,200 ,,
Hassan District	..	2,000 ,,

The cotton grown comprises quite three distinct types of cotton, *viz.*, the Upland type—Doddahatti or Dharwar-American, (2) the indigenous type—Sannahatti which is practically the same as the Kumpta of Dharwar and Hubli, and (3) the Nadam type, which is confined to the Mysore District. The total production, small as it is comparatively, is thus made up of three types. The cotton markets, however, are only two in number, *viz.*, Davangere and Chitaldrug where there are both gins and presses and large buying agents ; gins however exist in several other centres also, *viz.*, Harihar, Jagalur, Banavar, Holenarsipur, Mysore and Molakalmuru. Except in the tract within convenient carting distance of Davangere and Chitaldrug, much of the cotton marketed is what has already been bought by middlemen. The cotton handled in the two markets may amount to about 8,000 and 20,000 bales per year in Chitaldrug and

Davangere respectively. Societies can be thought of only in either of these two markets or both. It is a question how much of the above quantities come from a sufficiently compact area for the purposes of a society and what part of such quantity can be diverted out of the hands of local merchants and be made available for sale in auction or otherwise directly by a society of growers. Probably for many years to come and certainly in the earlier years it will not be possible to wrest a sufficiently large quantity, such as will attract large buyers from merchants' hands for purposes of auction. It must be recalled that the societies in Hubli and Gadag hold a number of auctions during the season : for the success of any similar society it will be necessary that the quantity should be sufficiently large for holding more than one auction.

There is, however, a feeling, undoubtedly strong, that growers are not getting what is really their due, under the present methods of sale through merchants and that they should combine and have their own sale agency. Some years ago a Co-operative Cotton Sale Society was started in Harihar which had subsequently to be wound up ; recently the leading growers in Chitaldrug issued a printed manifesto describing how they were losing by dealing with the merchants and urging the formation of a separate agency of their own : nothing, however, came out of this move though, judging by the names of the signatories, it had strong support. In both these centres, as already stated, the charges levied by the merchants are of the same class but the rate of commission is slightly higher, with the result that the total is higher than it is with Hubli and Dharwar merchants and more so than those of the sale societies there. But even at the somewhat high rate, it is doubtful if the same service can be performed at a lower cost, at any rate with the magnitude of the business that may develop in any such society : but even if a small saving can be made, I doubt if this alone will prove a sufficiently lasting incentive to ryots to patronise the society as against the merchants. There is the question of management of a society of this kind which would require a very experienced and honest man, who will have to be suitably paid and this matter may perhaps prove one of great difficulty. Where the society deals in the same class of cotton as the merchants, such as the local *sannahatti* or *doddahatti*, the competition may be found very severe even for a society of some

years' standing and for an infant society may prove fatal. For a mere sale of the local cotton, therefore, it seems to me there is little chance of success.

We are just now somewhat in the position in which the Bombay Department was some 20 years ago when they first started a society for the sale of their improved strain. We have now in the improved (*sannahatti*) strain, "Selection 69", raised on the Babbur Farm, a strain of cotton which is well spoken of by the trade, and for which, generally, a premium is offered over and above the price of the local cotton. The Department is working to introduce this cotton on as large an area as possible and has, during these few years, succeeded in spreading it over an area of roughly 20,000 acres; but the produce which comes into the market cannot be guaranteed pure. Unless some organization can guarantee purity it will be difficult firstly, to secure for it the premium which the pure strain can easily fetch, and secondly, to obtain supplies of pure seed for the succeeding season for a further extension of the area. A Co-operative Society that may be formed solely for this purpose or any existing co-operative credit society whose members can guarantee to grow only this strain and market it pure through their society, will secure both the above objects. In view of the great difficulty of forming and working new societies with the well-known paucity of competent workers, it may be wise to try and enlist the existing co-operative credit societies themselves in the work, if such societies of good standing can be secured. The example of one such good society may be the means of other similar societies taking up the same kind of work for their neighbourhood and it may be hoped that all the societies in a large tract may come into the scheme in course of time opening the way for a large joint central organization. If, as in the case of the Hubli tract, the Mysore State should also have the Cotton Transport Act in operation we should be able to have the whole of the Sannahatti tract growing only the improved strain, Selection 69, or any other improved strains which may be put out later on.

The association of one such co-operative credit society in this work as is indicated above has been secured and fairly satisfactory work has been accomplished during the last two years. This society, *viz.*, the Maradihalli Co-operative Society, is situated in the middle of a large cotton growing area in the Hiriyur Taluk of the Chitaldrug

District which has nearly 15,000 acres under cotton. The society is supplied with pure seed from the Department, the members grow this selected strain pure, pick and store the cotton pure and the society undertakes the sale of all such members' cotton jointly. The society has been selling the cotton not as kappas but as ginned lint put up in pressed bales. The cotton is all marketed in Chitaldrug and has earned a premium both these two years. The kappas is ginned under the supervision of the Agricultural Department and the seed is bought by the Department for sale to cultivators. Of course, at every step the Agricultural Department is in touch with the work and assists the society in every way. The society gets a loan from the Apex Bank for being advanced to these particular members pending the sale of the cotton through the society. The loan is returned promptly after the sale of the cotton, as a matter of fact, even before the due date. In the year 1929-30 a sum of Rs. 3,000 was thus advanced and in 1930-31 the amount rose to Rs. 5,000. The cotton sold was 38 bales and realized at Rs. 135 a candy of 500 lbs. while the local price was only Rs. 129. The total realization for lint and seed was Rs. 5,810. In 1930-31 the society sold 99 bales and realized at Rs. 105 per candy as against Rs. 100—the prevailing rate. The total realization for lint and seed was Rs. 10,492. Of course, there have been other savings which could not have been possible if the sale was by individuals through merchants, all of which has been quite appreciated. A few individual members have 'grousedʼ saying that they could have secured better prices and probably there will always be a few members of this type. But the society has gained a great deal of confidence in the work now : more members have agreed to join the scheme and at the last meeting the society discussed the desirability of effecting a forward contract for one portion of the cotton, keeping the remaining portion for a spot sale. This betokens commendable confidence and augurs well for the expansion of the work. It is true that the work alluded to is very small in magnitude as the quantity sold has not yet exceeded 99 bales. It indicates, however, good possibilities along the lines already indicated both in respect of bringing in other societies into this work and in respect of creating an agency for the securing of large quantities of pure seed for distribution.

But the method of effecting the sale of cotton of this improved

strain of cotton, whether it belongs to the societies of the above category or individual ryots, presents difficulties. We have been put to the necessity of approaching personally and by letter a number of prospective buyers, to whom evidently the small lots available with us have not appealed. It is very likely that if we can have one central place where we could provide storage accommodation for all the Selection 69 cotton that may be brought in guaranteed pure, we shall be making it easier for buyers to do business. The stock here can be also graded in the same way as is being done in Hubli and Gadag and thereby we can keep up a high ginning percentage in the cotton that may be raised from the seed supplied. The storing of the cotton will also enable us to sell at such time and in such quantities as may be advantageous. There can be no difficulty about the payment of advances on the produce stored as both the Apex Bank and the local Mysore Bank may be willing to furnish the necessary loan at a reasonable interest. In fact it will be well to copy the system of the sale societies described little by little confining, as far as possible, this kind of assistance to the sale of "Selection 69" cotton grown by members of co-operative societies or affording such produce some sort of preferential treatment or special concession. In the beginning, this may be found to be a small affair but it is bound to grow. In the beginning, moreover, the selling agency will have to be conducted entirely by the Agricultural Department and can, later on when it is well established and working satisfactory, be constituted into a co-operative concern with both co-operative societies as well as individual cotton growers as members. Unless the sale organization is started and worked by Government for some years in this way, I am afraid, the present marketing conditions will have to continue with no hope of improvement in both of the two directions indicated.

Much of the above information has been secured with the assistance of the Deputy Director of Agriculture, Dharwar and his staff, and from the Presidents of the two Societies, to all of whom I tender thanks.

APPENDIX I.

Marketing Charges.

I. Hubli.

Details of charges levied by the Co-operative Cotton Sale Society, Ltd., Hubli from the Seller (Grower).

Item of Charges	For kappas, *i.e.*, seed cotton	For lint (without cotton seed)
1. Dalali (Commission) ..	Rs. a. p. 1 0 0 per naga of 1,344 lbs. (48 mds. of 28 lbs.) for both private and auction sales.	Rs. a. p. 0 12 0 per naga of 12 mds. lint for both private and auction sales.
2. Charity ..	0 1 6 per naga.	0 1 6 per naga.
3. Pinjrapole ..	0 0 6 per doera (approximately four doeras weigh one naga of kappas).	0 0 6 per doera (two dokras of lint weigh one naga)
4. Hamali ..	0 1 3 per doera.	0 1 0 per doera.
5. Nit (stacking) ..	0 1 0 per doera.	0 0 9 per doera.
6. Insurance ..	0 2 0 per doera for private sale and annas 8 per doera for auction sale.	0 2 9 per doera for private sale and as. 8 per doera for auction sale.
7. Godown rent..	0 1 0 per doera per month.	0 1 0 per doera.
8. Sample ..	2 lbs. per doera are deducted for kappas in the weight before calculating the amount according to the rate sold. This sample of 2 lbs. is a gain to the buyer.	0 1 0 per doera (this goes to the buyer).

Charges levied by the Society from the Buyer.

Item of charges	For kappas	For lint
1. Commission ..	1 0 0 per naga of kappas for private sale and Rs. 1-4 0 per naga for auction sale.	0 12 0 per naga for private sale and Re. 1-0-0 for auction.
2. *Deduct* Charity	0 0 9 per naga.	0 0 9 per naga.
3. *Deduct* Namuna	....	0 1 0 per naga.

N.B. The Dalals do not insure the goods of the seller. Hence they do not charge for insurance. Besides they do not sell by auction sales. The auction sale rates are charged by the Co-operative Sale Organizations only. The rest of the charges are the same both in the market and the Co-operative Sale Organizations.

II. Gadag.

Commission and other Charges levied by the Gadag Society from the Cultivator.

Item of Charges	For seed cotton per naga of 1,344 lbs.		For lint per naga of 336 lbs.	
	By Sale Society	By Cotton Dalals	By Sale Society	By Cotton Dalals
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1. Dalali (Commission) ..	1 0 0	1 0 0	0 12 0	0 12 0
2. Hamali (Cooli) ..	0 4 0	0 4 0	0 2 0	0 2 0
3. Stacking	0 4 0	0 2 0	0 2 0	0 1 0
4. Insurance	1 8 0	....	1 4 0	....
5. Godown Rent ..	0 4 0	0 4 0	0 2 0	0 2 0
6. Pinjrapole	0 2 0	0 2 0	0 1 0	0 1 0
7. Boarding	0 1 0	0 1 0	0 0 6	0 0 6
8. Charity (Dharma) ..	0 1 6	0 1 6	0 1 6	0 1 6
9. Sample	....	....	0 2 0	0 2 0
Total ..	3 8 6	1 14 6	2 11 0	1 6 0

Commission and other Charges levied from the Buyers.

Item of Charges	For seed cotton per naga of 1,344 lbs.		For lint per naga of 336 lbs.	
	By Sale Society	By Cotton Dalals	By Sale Society	By Cotton Dalals
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
1. Commission	1 0 0	1 0 0	0 12 0	0 12 0
2. Pinjrapole	0 2 0	0 2 0	0 1 0	0 1 0
Total ..	1 2 0	1 2 0	0 13 0	0 13 0
Deduct Charity amount ..	0 0 9	0 0 9	0 0 9	0 0 9
Deduct Sample amount ..	....	....	0 2 0	0 2 0
..	1 1 3	1 1 3	0 10 3	0 10 3

If the cultivators hold the cotton for more than one month in anticipation of better prices or some other reasons, the cotton dalals charge 4 annas per naga of seed cotton and 2 annas per naga of lint for every additional month, till the produce is sold. The Gadag Cotton Society charges only 4 annas per naga of seed cotton and 2 annas per naga of lint whether cultivators hold in cotton for one month or more than one month till the sale is effected.

In the Sale Society all the cotton is insured, but in the market generally the cultivator does not get his cotton insured. Only in rare cases he does so.

The seller has to pay 8 lbs. of seed cotton per naga (of seed cotton) to the buyer in addition to other charges.

APPENDIX II.

The Gadag Co-operative Cotton Sale Society, Ltd., Gadag.

STATEMANT OF AUCTION SALE NO.

Details of Docras with percentage of Cotton in each class classified by the help of the Agricultural Department.

Class	Average percentage of lint to kappas of class	Average quantity of lint to kappas per naga	Number of docras in each class	Buyer's name	Rate
	4th	*Generation Upland.*			
		Mds. lbs.			
S. P. A. ..	34.0	16 7	10	The purchasers were :—	168
S. P.	33.0	15 23	38	Messrs. Syamji Karamati Sait, Hukamchand Mills, Sirur & Co., Gadag Mills, Bharat Mills, Santapa Koti, and Lakkanji Ladda.	164
I Class ..	32.0	15 10	169		158
II Class ..	32.0	15 10	17		157
			234		
				(The names are lumped together purposely by me and not given against the lot purchased by each, lest I hurt any properties thereby.)	
	5th	*Generation Upland.*			
S. P. A. ..	34.0	16 7	75		166
S. P.	33.0	15 23	238		163
			239		164
I Class ..	32.0	15 10	243		158
			243		158
			243		158
II Class ..	31.5	15 3	57	(4 Docras III).	156
			1,342		
	5th	*Generation Upland.*			
S. P. A. ..	34.0	16 7	32		167
S. P.	33.0	15 23	156		162
I Class ..	32.0	15 10	200		157
II Class ..	31.5	15 3	48		153
II Old	31.5	15 3	64		147
III Class ..	31.3	15 0	58		154
			558		
		Jayawant.			
S. P.	77.0	12 26	19		130

Class	Average percentage of lint to kappas of class	Average quantity of lint to kappas per naga	Number of docras in each class	Buyer's name	Rate
		Selected Kumpta.			
I Class ..	26.0	12 13	206		127
II Class ..	25.5	12 7	59	(12 Docras Old)	124
	Total ..		277		119
	Grand Total		2,430		112
Sample lint 5	Docras.				

Graded by G. V. JAMAKHANDI,
District Cotton Overseer, Gadag.

APPENDIX III.

Notice.

The Gadag Co-operative Cotton Sale Society, Ltd., will hold Auction Sale of Upland and Dharwar No. 1 *Kappas on* . . 193 *in the Compound of the Auction Depot.*

The following will be the terms for the guidance of the purchasers :—

1. The net weight of docras after deducting the weight of samples Bardan and Katan Kati is recorded in the register.

2. For each dry docra 18 lbs. are deducted for bardan, shrinkage, and sample. When a docra weighs 13 maunds or more, due deductions are made according to the Market System. The Society has taken all possible care in weighing the docras, but if the purchasers want to re-weigh some or all docras they may do so, but they will have to pay Hamali charges at the rate of Re. 0-1-6 per docra and the weight allowed for bardan, will then be 15 lbs. only for Kappas and 12 lbs. for cotton docra. In addition to this 1 lb. more will be allowed for Katan Kati.

3. Sample of 40 tolas of Kappas from each docra is taken from all the docras up to a limit of ten and the percentage of lint found out by ginning the seed cotton. When one person's docras exceed ten, sample for every ten docras is taken out separately and then the percentage of the lint is found out.

4. Docras are arranged in classes of different grades according to the high or low percentage of lint ; due consideration for cleanliness and mixture is given while classifying.

5. Information regarding the number of docras, weight, ginning percentage, etc., of each class will be suppplied to the bidders at the time of auction.

6. The purchaser is required to pay to the Sale Society a commission of one Rupee per Naga of the Kappas and 12 annas per Naga of the cotton and ½ an anna the Pinjrapole, according to the Bazaar System.

7. The purchaser will receive from the Society the Dharmadav at Re. 0-0-9 per Naga, and also 2 lbs. of Kappas per Kappas docra and one anna per Cotton docra as sample.

8. Merchants approved by the Managing Committee only are allowed to bid in the auction.

9. The purchasers will have to pay the value of Cotton or Kappas they purchase, in such manner, as will be settled by the Managing Committee of the Society from time to time.

10. Every purchaser must remove the docras of Cotton or Kappas within three days of the auction and if not removed. they will lie at the risk of the purchaser.

11. If the purchaser fails to remove the cotton purchased within 3 days of the auction, the Managing Committee may cancel the transaction and again sell it by auction and recover the loss.

12. The purchaser shall have to bear expenses of removing and watching, etc.

13. The Society may or may not accept any bidding in the auction.

14. Perfect grading is done under the careful supervision of the Officers of Agricultural Department.

15. Purchasers are at liberty to examine in any way they like the cotton graded, but no complaint of any kind. such as mixture, grading, soiled kappas, etc.. will be heard after the auction is over. All doubtful docras are kept in the lower grade. If the purchasers require any cotton for sample they will get it on payment.

16. If the Bazaar is dull on the day of auction or for any other reason, the Managing Committee may postpone the auction or cancel it.

17. These conditions are subject to the Bye-laws of the Society.

GADAG,
1*st April*, 1929.

V. A. SHETTI,
Manager.

V. P. CHAVADI,
Chairman.

The Place of Science in the Development of Mysore Agriculture*

BY

Leslie C. Coleman, C.I.E., M.A., Ph.D.,

Director of Agriculture in Mysore.

I feel greatly honoured in being invited to deliver this University lecture endowed by my old and esteemed friend Mr. V. Subramanya Iyer in honour of the Silver Jubilee of His Highness the Maharaja of Mysore. His Highness' profound interest in, and solicitude for, the rural population of this State and for the betterment of their condition makes me believe that my choice of a subject is not inappropriate. My great regret is that I am not better equipped for the occasion.

The subject of my address this evening is "The Place of Science in the Development of Mysore Agriculture". Lest I be suspected of a narrowness of outlook which is sometimes ascribed to the scientific worker let me say at once that the development of the agricultural industry in this fair State must depend upon many factors besides the accurate knowledge to be gained from scientific investigation in the laboratory or on the experimental farm. Agriculture is a business, not a science and the young man who would expect to make even a moderate success in agriculture solely on the basis of the results of scientific experiment would be doomed to disappointment.

Considered from a wider aspect, the regulation of agricultural production to the world's needs and the equally important organization of transport and marketing so as to ensure the least wasteful passage of products from producer to consumer should be susceptible of scientific investigation. Any one who has read even a little of the recent literature dealing with the subjects of the regulation of agricultural production and the marketing of agricultural produce must, however, have been struck by the hopelessly opposed conclusions that have been reached by different authorities and must have been forced to the view that political science has not yet evolved methods to deal with the large and complex problems that confront it, of an exactitude at all comparable with those which are in the hands of the humblest worker in the fields of the natural and applied sciences.

---

* The Sri Krishnarajendra Silver Jubilee Lecture, 1931.

While the sciences cannot be expected to help us to solve all the problems which confront us in Mysore in connection with agricultural development, few of us are, I imagine, prepared to question the statement that they have a very important rôle to play in that connection. I shall not attempt to deal with what has already been accomplished in this direction. I have been so closely identified with this work that I could, perhaps, hardly be expected to deal with it from an unbiassed standpoint. I should, however, like to say that all of us who have been concerned with the organization and prosecution of scientific work in connection with agriculture during the past quarter of a century fully realize that we have done little more than lay foundations for the future. It is for those who come after us to judge whether those foundations have been laid so that the future edifice can rise stately and sure upon them.

Instead of attempting to describe work already accomplished, I should like, rather to present to you the problems of the future as I see them and if at the close of my remarks I have to some small degree fired the imaginations of the young men in this audience, among whom are to be found some of our future scientific leaders, I shall feel that I have not entirely wasted your time and mine.

Firstly I should like to impress upon you the amazingly good fortune of those whom fate has ordained and will ordain for scientific investigation in connection with agriculture in Mysore. I am not referring here to the glowing financial prospects which await such men. As in the past so in the future your money rewards are likely to be decidedly meagre. I am referring to the great importance of this work to the future prosperity of this State and to the almost overwhelming variety of the problems with which you are faced.

I need hardly point out to you that Mysore is essentially an agricultural country and that as far as we can now see it is likely to remain so. I need perhaps also hardly remind you that nearly one-half of the State's revenue is derived directly from the agriculturist and that of the rest a very considerable proportion is derived either from the owners or tenants of land or from the labourers on it. If, therefore, this State is to take that place in the future commonwealth of India which we believe she should occupy it must be very largely through the development of this great industry. The steady progress of Mysore must be based on the increasing prosperity of her

ryot population. To hope for a prosperous and enlightened Mysore, with, at the same time, a poverty-stricken ryot population would be absurd.

While there are other parts of India which may be destined, in the future, to remain as essentially agricultural as Mysore, there are, I believe, few if any other parts, where the problems facing the agricultural investigator are so varied and where through the compactness of the area and the natural intelligence of the agricultural population, the conditions are so favourable for testing and introducing improvements resulting from scientific investigation. Let us first consider the variety and complexity of the problems. These are conditioned primarily by the great variety of climate and soil. It is true we have not that marked variation in temperature which gives the agriculture of North India two crop seasons in which tropical crops regularly alternate with those of the temperate zone. We have, however, a variation in rainfall both as regards amount and distribution which would be hard to duplicate in an area of similar size anywhere outside Mysore. We have in the western part of the State a rainfall going upto three hundred inches per annum while in certain of our eastern taluks it sinks below 20 inches per annum. There are areas of the State where the main sowing season for dry crops is the month of May while in others less than twenty miles away it is July or August. In fact there are areas such as those in Chitaldrug District where a range of hills in places less than five miles wide almost entirely changes the character of crops and the time of sowing on its two sides. The character of our soils varies not only over wide areas but also within short distances almost as greatly as does our climate.

All of this has brought about a very striking complexity of crop species and varieties and also of agricultural methods to suit more or less exactly these variations. This can be illustrated by the striking variations in our main food crop, ragi which covers an area of approximately $2\frac{1}{4}$ million acres in this State. In the *malnad* to the extreme west ragi is a crop of insignificant importance but evidence is not lacking that in the past it has occupied a much more important area than it does now for there are many signs of former cultivation in the higher land above the areca gardens and paddy fields which

are the characteristic feature of our northern *malnad*, and undoubtedly a very much larger amount of food grains including ragi must have been grown in that area in those days to feed the much greater population that inhabited the *malnad*. There is also experimental evidence that as good crops of ragi can be grown in this region as in many other parts of Mysore.

Immediately to the east we have the semi-*malnad* where special seasonal varieties of ragi, the *kar* or *gidda* ragis, are sown usually in May and as we travel eastward these gradually give place to varieties, the *hain* or *dodda* ragis, which are sown in July and August or at times, as late as September. These seasonal varieties although they represent very much the same types from the botanical standpoint, are apparently closely adapted to the seasons when they are usually grown so that if they are moved out of their natural habitat to new areas they do not do nearly as well as the varieties usually grown in such areas. Within each climatic area we have a fairly large number of botanical varieties quite distinct in appearance. These are quite commonly found more or less mixed in the ryots' fields. In addition to these dry land varieties we have a very considerable number grown under irrigation.

What applies to ragi applies to many other dry crops in the State. It applies to a lesser extent to our main irrigated crop, paddy, but here irrigation comes in and naturally disturbs the play of climatic conditions.

To indicate the extent of soil variation in Mysore I need only point out to you that Dr. Narasimha Iyengar in his soil survey of the Irwin Canal area which he is now bringing to completion, has found it necessary to take soil borings on an average for every 15 to 20 acres of the 120,000 acres surveyed, in order to get a reliable picture of the soil conditions in the area. I doubt if such an intensive soil survey has ever before been made of any corresponding area nor is such an intensive survey usually necessary.

I have used these illustrations to enable you to gain some small conception of the complexity of the problems which face the scientific workers of the future in this State. I shall now turn for a few minutes to a very general and imperfect survey of some of our main problems.

One of the first problems to be tackled in connection with the improvement of agriculture in any country must be the supply of seed of the best and highest yielding strains of the important economic plants grown. This is especially important in Mysore for there is no other agricultural improvement which can be introduced at so little cost to the cultivator. The seed required for one acre of ragi costs at present prices about 8 annas which is a very small part of the total cost of cultivation. I shall not go into the question of the technique used in the production of new varieties but shall simply point out that in a field of ragi as ordinarily grown by a ryot there are a large number of strains differing greatly in vigour, in yielding capacity, in the time required for coming to maturity and in such other important points as freedom from grain shedding, amount and strength of straw and resistance to disease. It is the work of the botanist to select from this rather bewildering mass not in one field only but in fields covering large areas those plants which he considers will combine the greatest number of desirable qualities placing yield at the top. It must be obvious that even this work can hardly have finality for the selection of the very best plants from two million odd acres is a task upon which work can well continue almost indefinitely. Even were we confident that the very best strains now available had been found we should have to have different strains suited to our different climatic and soil areas, which means the final selection not of one strain but of possibly a dozen. More than this we should almost certainly find that no one strain approached the ideal in all respects and that it would be only through the combination of the qualities of several different strains that the ideal could be approximated. This introduces the necessity of carrying out the fascinating but complicated task of hybridization through which we may hope after long effort to obtain the desired combination. I may point out that the work on the development of new strains by hybridization is yet in its infancy in India.

In this connection it is of great importance to have a very comprehensive collection of all the different varieties at present existing to use as possible foundation stock, for these old varieties which have been grown probably for thousands of years have frequently qualities of hardiness and resistance to disease which are in great danger of being lost in the process of breeding for increased yield and better

quality. This has been only too frequently the result of breeding work in western countries and there is now a marked insistence on the necessity of retaining the old varieties on experiment stations so that they can at any time be used as foundation stock for future breeding. It may interest you to know that we have on the Hebbal Farm a collection of no less than 300 varieties and strains of ragi representing not only the different climatic areas of Mysore but also the regions in British India where ragi is being grown.

But ragi is only one crop. As a matter of fact there are listed in the *Mysore Season and Crop Report* no less than 36 important crops grown in the Mysore State and these represent only a small part of the total. Of these we have been able to deal, even in a preliminary manner, with less than ten crops and in the case of only five have we reached the stage of being able to give out seed for general growth or for preliminary testing by the ryots of Mysore. I may point out that the results so far obtained have come almost entirely from the labours of two men Dr. V. K. Badami and Mr. V. N. Ranganatha Rao. When I tell you that from five to seven years is looked upon as the shortest time required to bring a new selection of an annual crop to the stage of distribution and in the case of a perennial crop such as coffee this period must be multiplied by three or four you will be able to understand something of the immense amount of careful scientific labour involved.

The production of new high-yielding strains of economic plants, while immensely important, cannot lead us very far in agricultural development if we stop there. As a matter of fact it has been estimated in Europe that this method of crop improvement has been responsible on an average for an increase in yield of about ten per cent, although of course increases in individual cases have been much higher than this. The increases that have been registered in ryots' fields from our work in Mysore have varied between ten and twenty-five per cent.

It must be obvious in a country such as Mysore standing as it does on one of the oldest geological formations in the world and where conditions do not now allow and have not in the past probably for many centuries allowed for enrichment through the deposit of silt except in restricted areas under canals and tanks, the soil must have reached an equilibrium such that about the same amount of plant

food material can be taken away in the crop as is added to the land in the form of manure. If, therefore, we introduce new strains which can feed more efficiently on the soil than those we are replacing, it stands to reason that there must be a gradual, if perhaps at first imperceptible, lowering of soil fertility unless we increase the amount of manure applied to the soil. The tendency of high-yielding strains to exhaust the soil has already become apparent to the ryots in the Cauvery channel areas where a high-yielding strain of paddy developed by the Madras Department of Agriculture has largely replaced local varieties. It is the general view of growers that this new variety, although it gives higher yields, also demands more manure.

From this it will be seen that work on the manurial requirements of Mysore soils must go hand in hand with work on the improvement of our crops through breeding. In other words the chemist and the trained agriculturist must work in close co-operation with the botanist. I have already pointed out the very marked diversity of Mysore soils ; so the work required in connection with them and their manurial requirements is enormous. Then we have the special manurial requirements of the different economic plants grown in various parts not only as to quality but also as to quantity. Up to the present these investigations have been confined to only seven of our important crops.

In regard to the manuring of even these comparatively few crops our knowledge is far from complete. It is true we do know the particular plant foods supplied in manure to which these crops react by increased yield and we are even able to advise in a general way on amounts and proportions of plant foods which will, under average conditions, give a profitable return on the money invested. In most cases, however, we cannot say definitely what is the maximum amount of plant food in the form of manure which can be profitably applied. An immense amount of experimental work in this direction is still required even on the few crops we have under experiment.

It seems certain that if we are to increase our production to anything like the standard of western countries we shall have to take much more largely to the use of artificial fertilizers and more especially nitrogenous and phosphatic ones. Our soils are in general very poor in the two important plant foods—nitrogen and phosphates. Our

local supplies are entirely inadequate and even then are decidedly more expensive per unit of available plant food than the artificial fertilizers now available. No one, I think, seriously looks upon the so-called chemical fertilizers as more than supplementary to the supplies of manures available to the ryots but there seems no doubt whatever that in this regard they can and should play a rôle of immense importance. There is evidence as far as food grains are concerned that samples from fields manured by the so-called natural fertilizers such as cattle manure do contain more of the essential vitamines than those from fields manured solely with artificials. Even if we accept the work already done by Mr. Visvanath of the Madras Agricultural Department in co-operation with Col. McCarrison as conclusive on this point, it may be pointed out that there are a very large number of our commercial crops in which vitamine content cannot come into the picture at all. This is the case with sugarcane, one of the crops on which fertilizers can be used with the greatest profit. I believe I am safe in saying that the final product from sugarcane whether it be jaggory or sugar can hardly contain any vitamines. The same applies to such valuable crops as coffee, arecanut, and tobacco where the produce after preparation for consumption or in the form in which they are consumed can hardly provide to man any of the vitamines we now recognize as so necessary for growth and health. I could name many other important agricultural products which come under the same category but those I have mentioned should, I think, suffice. It seems to me necessary to emphasize the importance of realizing that in any consideration of the use of fertilizers in this country in the future, the needs of Indian agriculture should be considered as of paramount importance and that merely political considerations should be carefully excluded.

If, as I anticipate, artificial fertilizers increase greatly in importance in Mysore during the next quarter century, the necessity for most careful scientific investigation in connection with their use must, I think, be obvious. Whereas, in the case of such natural manures as cattle manure and green manures, the manure is obtained at small cost to the ryot and it is practically impossible to injure the crop or the soil by any application that is generally possible under existing conditions, in the case of artificial manures very much more care must be exercised. We must know which of a number of

different manures will give the best results and what particular amount of application will give the highest economic return. As many of these artificial fertilizers are made available to the plant almost immediately after application, the stage of the plant's growth at which they can most profitably be applied is another question of great importance. In all these directions our present knowledge is extremely meagre.

As far as our dry crops are concerned the plant foods in the soil are frequently not the limiting factor in crop production. Production is limited very largely by soil moisture which again depends upon the rainfall. Obviously drought resistance must be a most important character in our improved varieties. Recent work in the United States and Canada goes to show that the chemist can assist the plant breeder greatly in connection with the elucidation of the characteristics upon which drought resistance depends. This question which has hardly been touched upon in India is a fascinating and important one for future study. The effect of manurial treatment on the moisture-holding capacity of soils and on the ability of plants to increase their root systems so as to utilize the soil moisture more efficiently is another important question where the chemist, the physicist and the physiological botanist must join hands.

We cannot turn from a consideration of soil problems without reference to the very important problems of cultivation. As you may be aware our most important cultivating implement is the plough. The wooden plough which has been used in this country for many centuries has, it is true, the virtue of cheapness but it is anything but an efficient implement. Dozens of different types of plough have been imported into India but only a comparatively few have proved at all suitable for Indian conditions. Even among these there is, I venture to state, not a single one which is much more than an approximation to what is required. Probably the soils of Mysore place as large and as varied a demand on a plough as any in India and we have, I believe, in this State a larger number of improved ploughs *per capita* than in any other part of this great country. The question of materials to be used for efficiency and wear is as important as the question of design and in both directions there is an immense amount of scientific work to be done. It may interest you to learn

that the Department of Industries and Commerce and the Department of Agriculture are working in close co-operation on this problem at present. I may say, however, that young engineers and metallurgical chemists, if there are any of the latter in the University, need not fear that we shall have exhausted all the possibilities of improvement in this direction by the time they are ready to start their life's work. In any case I may point out to them that the plough is only one of many agricultural implements and I believe agricultural development will, in the future, demand changes both in design and materials in many, if not most, of these implements.

Let me turn to two fields which are particularly the home of the biologist. I refer to the study and control of insect pests and plant diseases. No estimate at all accurate has ever been made of the toll these enemies of the agriculturist levy on the Indian ryot every year. It is true that Mr. Fletcher some years ago estimated the annual losses in South India from insect pests alone at 30 crores of rupees. The losses from both insects and fungi must run to many hundreds of crores of rupees for the whole of India. To give you an illustration of the serious losses which may be caused by a plant disease I may remind you that a disease of *Supari* (Koleroga) not uncommonly destroys 75 per cent of the crop in an areca garden. This disease has played a much more important rôle than most people realize in the impoverishment of the Shimoga *malnad*. Scientific investigation by the mycological staff of the Department has led to a fairly effective method of control of this disease which has been widely adopted by the garden owners but it would be a great mistake to think that we have reached even in this one comparatively small field anything like finality. Recent work of Mr. M. J. Narasimhan, which is of great scientific as well as of great practical import, has opened up possibilities for a more effective and at the same time much cheaper method of control. It would take me much too far to describe to you these investigations and their results but I would refer young workers in botany to Mr. Narasimhan's comparatively recent publication which they will find fascinating reading. Practically all our cultivated crops are attacked by serious fungus diseases the majority of which still remain entirely or almost entirely uninvestigated. The possibility of breeding varieties resistant to disease, a subject which is being investigated with feverish energy in western

countries, remains in India still almost unexplored. Here is a field in which the plant breeders and the plant pathologists of the future will find a most fascinating and important field for co-operative effort.

If we turn to the question of insect pests we have an equally large field. As in the case of plant diseases our ordinary field crops usually allow for only the cheapest methods of control. This in turn demands a most thorough investigation of the insects concerned from the biological and physiological standpoint, otherwise it will be impossible to decide upon the effective method and the effective time of application. The name of Dr. K. Kunhi Kannan whose recent death has been a very serious loss to the agriculture of this State will, I believe, find enduring association with entomological investigations in this State, more especially with reference to the devising of methods of insect control adapted to our conditions. Dr. Kunhi Kannan displayed a real genius in this direction and his is a shining example for the entomologist of the future. One of the last problems on which Dr. Kunhi Kannan was engaged is the utilization of some of the many local fish poisons derived from wild plants, in the control of injurious insects. Although we already know that some of these fish poisons furnish very efficient insecticides and that the plants from which they are derived are present in great abundance in our forests a very great deal of work remains to be done on such important questions as the particular part or parts of these plants which will yield the effective poison in the greatest quantity, and the most efficient as well as the cheapest method of extraction. I may point out in this connection that an immense amount of work in this direction is at present being carried out by scientists in America on plants obtained from other tropical countries. I see no reason why we may not expect to be able to obtain just as valuable results from our Indian products as the Americans have already obtained from plants they are investigating.

I have touched upon only a very few of the great multitude of scientific problems that lie before us in connection with the development of agriculture through scientific investigation. If I have not failed utterly in my task this short review must have impressed you with the fact that a very large number of scientific workers could be engaged on these problems to the profit of Mysore agriculture. I

am not a prophet and am not able to predict what will happen during the next ten years in this State. I think, however, it is safe to say that we shall not have workers at all comparable in numbers and ability to the importance of the problems which face us. This is a rather depressing thought but life has always seemed to me a struggle with almost impossible odds and still we keep on struggling. There seems to be one ray of sunshine in the gloom and that is the possibility of mobilizing larger forces than are at present available. These forces need not be confined to the pitifully meagre army of men in the Agricultural Department. I can see no reason why the University should not play a noble part in this work. It may interest some of you to know that a beginning in this direction has already been made and that I hope we shall soon see the scientific departments of the University through the staff and also I hope, through graduate students, in steadily increasing numbers actively co-operating in the investigation of important scientific problems connected with agriculture. To the young men of this audience let me say that if you have not yet tasted the joys of adding to the world's sum of scientific knowledge, if you have not yet been thrilled by the thought that you have wrung from the heart of nature some small secret which no one has heretofore known, you have something of great value to anticipate. To me, a small contribution to the knowledge from which can result an economic condition of the agriculturists of this country would be a more satisfying monument than any of stone or bronze or gold that has ever been erected.

SELECTIONS.

New Rice Research Scheme in India

EMPIRE MARKETING BOARD MAKES A GRANT.

The Empire Marketing Board has made a grant of £15,790 (Rs. 2,03,279) spread over five years, towards a scheme for the development of rice research in India which aims at increasing the yield and improving the quality of Indian rice.

The scheme is organized by the Imperial Council of Agricultural Research of the Government of India. The Empire Marketing Board has offered to bear half the cost of developments in Burma, the principal rice exporting Province, and Bengal, where Patna rice is grown for export. Schemes for development of research in the remaining five Provinces are to be financed entirely by the Imperial Council.

VAST RICE AREAS IN INDIA.

The area under rice in India is nearly half as much again as the whole area of the United Kingdom. About 33,000,000 tons are produced annually of which only a small proportion is exported. The United Kingdom imports about £1,790,000 worth of rice annually from all sources. The scope for research is immense. Improvement may come through breeding better varieties of rice already grown in India, or through establishing there new and better kinds of rice from other countries. A beginning has already been made and over a million acres are under improved varieties.—*The Planters Journal and Agriculturist*, Vol. XIV, No. 18.

Nitrogen in Farm Manure

When manure is stored under anærobic conditions two changes take place; namely, the area and water-soluble nitrogen change to ammonia, and an acid fermentation takes place with the formation of volatile organic acids which react with the ammonia, forming salts.

The losses of nitrogen from farm manure come both in the storage and handling processes. Under extreme conditions these losses combined may be almost one-half of the total nitrogen or nearly the whole of the liquid manure nitrogen. The loss of nitrogen is due to the volatilization of ammonia either as the carbonate or as the salt of a volatile acid. The former seems to be lost most rapidly during the early drying

period and the latter when most of the carbonate is gone. The ammonification process results in an increase in the p_H value and the fermentation process causes the p_H value to decrease, and this decrease is in direct proportion to the amount of straw or energy material present.

When liquid manure is stored alone, the nitrogen changes to ammonium carbonate and is lost from the solution by volatilization. This loss may be reduced to almost nothing by covering the surface of the liquid with a thin layer of mineral oil. Although the container may be open, there is practically no loss of nitrogen through the oil layer.

Straw as bedding in the manure tends to reduce the drying losses of nitrogen, but at the same time it reduces the availability of nitrogen.

An approximate measure of the nitrogen available from farm manure is obtained by the difference between the water-soluble or ammonia nitrogen and the losses of nitrogen from the manure during storage and handling. If there is no loss of nitrogen from cattle manure, 50 per cent of the total or 100 per cent of the liquid manure nitrogen should be recovered in the first crop under normal conditions. A smaller recovery than this is probably due either to loss of liquid manure nitrogen or the use of excessive amounts of straw as bedding.—*Soil Science*, Vol. XXXI, No. 5.

Habits and Control of the Coconut Black Beetle
(*Oryctes rhinoceros*, L.)

Until recently the losses caused to coconut in Ceylon by *Oryctes rhinoceros*, L. [*R.A.E.*, A., x, 582, xvii, 568] were usually considered negligible, and the factors responsible for its increase are discussed. The damage experienced in other countries is reviewed from the literature. The problem of this Dynastid in Ceylon centres mainly on its breeding-places, which consist of dead and decaying coconut logs, cattle manure and refuse of various kinds and are discussed in some detail. Moisture is a necessary condition in the breeding material, but the larvæ cannot exist in sodden or water-logged conditions. Coir dumps at fibre mills were found to be free from infestation, but larvæ may occur in the decaying humus round the edges of the heaps and in drains silted up with coir dust and vegetable matter. Coconut husks may be buried in any soil as long as no woody material is incorporated: they are of value for humus in light soils, in which woody material should not be buried. Trenches in which cuttings of *Tephrosia candida* were buried for green manure were free from infestation after two years.

Dead trees should be felled and the crown severed, the cabbage burnt and the trunk cut into logs, which should then be split in four. Manure

heaps should be disposed of within three months, the pests present being burnt. Vegetable refuse and town garbage should not be buried on light, porous soils and on heavier soils should be covered immediately with a foot or more of well-pressed soil. On light soils vegetable matter alone may be scattered in thin layers and covered in with a harrow to form a mulch. Fallen coconut branches, etc., may be used as a surface mulch on sandy soils after the thick woody portions have been removed and burnt. The ashes have a manurial value. The practice of burying logs to attract the ovipositing females is undesirable ; a simple trap may be made by placing a thick layer of cattle manure at the bottom of a shallow pit and covering it with 6 inches of straw. The pit should be re-made and the insects destroyed every two months.—*Review of Applied Entomology*, Vol. XIX, Ser. A, Part 12.

Russian-Grown Tea.

As part of the Russian Five-Year Plan an attempt is being made to multiply tenfold the production of tea in the Caucasus for Russian home consumption. It has long been known that Georgia has a climate and soil suited to the cultivation of tea, and as long ago as 1847, seed was planted there experimentally, but it was not until about 45 years later that the industry reached commercial dimensions. The real father of tea-planting in this part of the world was Mr. C. S. Popoff, head of the famous tea-trading firm of that name. In 1893 he planted 385 acres with China tea seed, later introducing Ceylon and Indian varieties, bringing expert tea planters as instructors, and building a modern factory.

Inspired by his example, the Russian Government planted up 600 acres at Chakva and did much to encourage others to develop the industry, and, by 1913, some 1,825 acres were under tea cultivation in Georgia. In 1925, the Soviet Ministries of Agriculture of two or three smaller Southern Republics, aided by the Central and Trans-Caucasian State Banks, joined with the Co-operative Societies to form a State Corporation to promote and control the cultivation of tea, and by 1930, 36,000 acres had been planted and over 50,000 peasant households had become engaged in the industry, some organized in collective farms or plantations, some working individually. Three experimental tea stations have been established in Gur, Adzharistan and Mingreli, to determine the types of seed and the methods of cultivation most suited to the district. Production estimates for the near future are :

1931, 1,760,000 lbs., 1932, 3,300,000 lbs., 1934, 10,670,000 lbs., when there will be 29 factories in operation.

We have tasted samples of some of these Chakva district Georgian teas that have been received in London this week. There are six grades : Flowery B.O.P., tightly twisted leafy broken, with very showy golden tip, rather like a Darjeeling in appearance ; bright infusion, full, fairly pungent liquor but with no distinctive flavour. Orange Pekoe, very thinly rolled, straight black leaf of good length, bright infusion and lightish neutral cup. Pekoe, neat, regular fairly black leaf, plain lightish cup. Broken Pekoe, very small, almost on Fannings, with a little tip, cup not so stout as size of leaf would suggest. Broken Pekoe Souchong, neat open leaf. Pekoe Souchong, good sized greyish black leaf.

All are clean sweet liquoring teas of non-descript neutral character with no trace of commonness or burn. They evidence careful manufacture and grading, and indeed are a most interesting lot. It remains to be seen whether from the climate and soil of Georgia, it will be possible to produce any characteristic flavour.—R. O. Mennell & Co.'s Tea Market Report. *The Planters' Chronicle*, Vol. XXVI, No. 25.

Preparation of Vinegar from Coffee Fruit Pulp.

By F. W. Freise.

The raw material is the pulp which covers the two seeds or beans of the cherry-like coffee fruit and which is freed from the seeds in the so-called "wet process of coffee preparation". The ripe pulp is of a bright scarlet colour and amounts to 40 per cent of the weight of the entire berry. The average composition of the pulp may be figured as follows :—

	%
Moisture	42.660
Volatile oils	0.112
Waxes, fats, resins	1.184
Tannins	8.557
Raw fibre	27.445
Sugars	9.455
Mineral substances	3.772
Not specified	6.815

The maximum amount of sugar, 12.553 per cent, was found in a sample of Botucatu coffee in complete state of ripeness. Among the

sugars, glucose and sucrose may be identified; the highest amount of the latter was found to be 1.25 per cent.

To secure a rapid and uniform fermentation, the pulp must be reduced to a mash. When this mash is pasteurized at 75°C. during 45–55 minutes and then inoculated with a culture, *e.g.*, of *Saccharomyces octoporus*, a good fermentation sets in within 24 hours (temperature being held at 23–25°C.) and reaches its climax on the fourth day. After 12 days the fermentation is complete and clarification must follow. Calculated on 100 grams of sugar, an average of 43.5 grams of alcohol is present. The specific gravity of the liquid is about 1.006, and the acetic acid contents, 0.25 gram per 100 cc.

When this liquid is acidified in barrels filled with wood chips slaked in previously prepared strong vinegar, the temperature of the acidification room being held at 35°C., the vinegar which results is of a clear Rhine-wine colour, has a smell like pear oil and a taste resembling old whisky. The taste disappears within 3 or 4 weeks of storage and the colour clears up somewhat.

The vinegar has a specific gravity of 1.0154, a total acid content, as acetic acid, of 4.60 per cent, traces of ethyl alcohol, 3.67 grams of solids and 1.29 grams of ash in 100 cc., 0.97 gram or 75.2 per cent of this ash being soluble.

Mash which is not completely ripe admixed to ripe mash causes the fermentation process to come to a standstill after some hours of slow fermentation. The motive is the presence of great amounts of salicylic acid in the pulp. Methanol derived from the pectin in the fruit is present in over-ripe mash. Unpasteurized mash always shows amyl alcohol in the fermented liquid, and during fermentation a strong ammoniacal odour denoting the bacterial activity on amino acids is experienced.

The vinegar output is on an average about 74 per cent of the theoretical.—*Industrial and Engineering Chemistry*, Vol. 23, No. 10.

World Cures for the World's Economic Ills.

In an article lately published in the *New York Times*, Mr. T. L. Chadbourne conceives the solution of the problem of constantly recurring periods of over-production of staple commodities as lying in world commodity agreements of the kind recently completed for sugar known as the Chadbourne Plan—which the author was himself largely instrumental in negotiating. The following are extracts from Mr. Chadbourne's article :—

"The most encouraging thing about the present position is the increasing realization of the need for attacking world economic ills in a world-embracing manner..... To-day, inter-European or even international co-operation, in its limited expression, is not sufficient to meet the new challenge. We must have world-embracing economic arrangements, binding all the producing and exporting nations to an accord which will, so far as it is humanly possible, insure a more rhythmic flow of business and prevent the return of these 'inevitable' world depressions which are not inevitable at all."

"Inasmuch as the world crisis is attributable to the unhappy trilogy of over-production, accumulation and depression, it might be well to consider the manner in which we attacked the world sugar problem, one of the worst crises confronting any commodity and typical of present conditions. First, we segregated surplus world stocks for orderly marketing over a period of five years. Second, we placed a rigid restriction upon output in the chief exporting countries of the world so that future output, *plus* annual sales of segregated surpluses, will equal and not exceed consumption. Third, we secured governmental sanction to control the arrangements made, so that recalcitrants can have no opportunity to take advantage of their fellows."

"In the past, there has been, so far as I know, no thought given to the manufacture and marketing of sugar from the stand-point of the industry as a whole."

"The Units (whether corporations, co-partnerships or individuals engaged in manufacturing and marketing the product) have been managed with varying degrees of efficiency, but with rare exceptions, without co-operation among themselves even within national borders."

"A large percentage of the Java producers for many years co-operated wisely and successfully in the marketing of their output, but this did not save the island from serious over-production this year; and Java producers, so far as I am aware, are the only instance of continuous joint selling by practically all the producers of any nation."

"Generally speaking, both production and marketing have been conducted the world over by the comparatively small units engaged in the business purely on a competitive basis."

"The old adage, 'Competition is life of trade,' contains a half-truth than which there is nothing more dangerous, but recent developments in the commodity situation of the world indicate that unrestrained competition is likely to be the destruction of society and has opened the eyes of the business world to the necessity of at least tempering this

worn-out statement by the addition of one word and making it read, in future, 'Enlightened competition is the life of trade.' "

"Enlightenment in a great industry is only obtainable by co-operation."—*The Journal of the Ministry of Agriculture*, Vol. XXXVIII, No. 7.

An International Enquiry on the Biological and Artificial Control Measures of Nut Grass (*Cyperus rotundus*)

The spread of the weed known under the botanical name *Cyperus rotundus* L. (Cyperaceæ) ; the difficulty not merely of destroying it but also of preventing it from invading lands previously not infested ; the very wide area of distribution which is not precisely ascertained but extends from the warm temperate regions to the tropical regions of America, Asia and Africa ; our scanty knowledge of its natural enemies and of any antagonisms there may be between it and other cultivated or wild plants, make necessary an understanding between all engaged in studying the problem of the control of *C. rotundus*.

It would be desirable first to obtain information on the following points :—

(1) Among the countries wherein the presence of this weed has been noted, those in which the plant actually constitutes a problem for the agricultural development of the infested zones ; in other words to ascertain : (*a*) whether there are countries or zones in which *C. rotundus*, although present, does no damage direct or indirect, or where it is supposed that it does no harm nor in any way hinders agricultural development ; (*b*) the reason for this.

(2) The animal or vegetable parasites, even of small importance which may exist in countries where *C. rotundus* is found, with all possible information as to their nature, their ascertained or presumed effectiveness, the possibility of introducing them into countries where they do not exist, etc.

(3) Antagonisms existing between *C. rotundus* and any other plant, wild or cultivated, and in consequence the possibility of using this means of control.

(4) The practices locally adopted for destroying or reducing the infestation or for preventing wholly or partially the spread of this weed in zones previously not affected, including alike practices the value of which has been determined by means of experiments and such as are

only empirically employed, with some indication of their ascertained or presumed effectiveness.

(5) The possible artificial control measures, destructive or preventive, which have been tried with more or less success, or even with negative result ; their description, cost of the applications, etc.

(6) The direct or indirect damage to crops, ascertained or presumed, resulting partially or wholly from the presence of *C. rotundus*, as well as the ascertained or presumed causes of damage which have some relation to the plant in question.

(7) A list of the Governments, scientific institutions, centres of research and individuals interested in the idea of collaboration in an enquiry into *C. rotundus*, and in the means for its control.

All proposals for the further development of this subject whether by enquiry, experiment, organization, etc., will be welcomed and published as speedily as may be possible in this *Bulletin*.

A series of experiments, instituted in the Dominican Republic, has given the following results :—

(*a*) A higher evaporation has been ascertained of the lands seriously infested, the increase in evaporation varying from 25 to 75 per cent as compared with lands not infested by *C. rotundus* : such evaporation of water was ascertained by a study of the loss of water in Livingstone atmometers and radio-atmometers placed at the level of the growth of *C. rotundus* and on the adjacent non-infested soil, other conditions being equal. Although this explains the impossibility of cultivation of land seriously infested, if situated in zones of scanty precipitation (the semi-arid zones), it does not explain why in zones, where precipitations are abundant, comparative experiments on a reduced scale, using maize and beans, gave from 10 to 25 per cent less of the product.

(*b*) The existence of animal or vegetable parasites attacking *C. rotundus* has not been verified.

(*c*) The effect of cover crops has been variable in relation to the main crop and its duration ; the best results have been obtained with the forage crop *Melinis minutiflora* Beauv., together with reptant and leafy varieties of *Ipomœa batata* L., among the cover crops which have a direct production value also.

(*d*) Semi-permanent coverings, with tarred cardboard, sheets of galvanized iron, etc., of the affected plots are effective but their use is too costly.

(*e*) As regards chemical substances of which trials have been made, the best results have been secured by strong applications of carbon bisulphide projected into the soil (500 g. per m^2) : this method also is very costly.

(*f*) An antagonism has been noted between *C. rotundus* and *Ricinus communis*, if the latter is grown in such a way as to shade completely a defined area ; it has been possible to ascertain by means of comparative experiment that this effect is not merely to be ascribed to the fact of shading.

(*g*) All agricultural work, and more especially ploughing and harrowing, if not carried out with suitable precautions. has a tendency to encourage the spread of *C. rotundus* over the adjacent plots, while these operations have no perceptible effect in diminishing distribution of the weed over any particular area ; in fact the effect is frequently the opposite to that desired.

(*h*) Diffusion in areas favourable to growth, even if not adjacent, takes place by means of transport of seeds of *C. rotundus* ; the seeds reaching distant points by means of water-ways of all kinds, rivers or canals and even road gutters : accordingly irrigated lands, and those traversed by rivers, torrents, canals, etc., and lands lying near roads are infested or liable to infestation more easily than other lands.—*International Bulletin of Plant Protection*, Year 5, No. 8.

Factors of Quality in Copra.

By F. C. Cooke,

Assistant Chemist for Copra Investigations.

Well prepared copra is white, of low moisture content and brittle, the pieces of copra being of good size and without ' smell''. The meat is of good thickness and has a high oil content. If these conditions are satisfied, the copra will arrive in Europe insect and mould free,—white and sweet.

Colour.

Besides yielding a colourless oil, white copra also yields a light-coloured cattle cake. Caramelized, superficially burnt, or black copra yields an oil of varying redness which may in some cases be only partially bleachable and a cattle cake which the farmer will reject on appearance

and perhaps also because of the smell of associated distillation products from the drying fires. It is also suspected, but not yet confirmed, that insects are especially attracted by slightly burnt copra, particularly where cell rupture has occurred.

Moisture.

Wet copra is the standard product bought by the local dealers in native copra because at certain seasons of the year—notably in November and December—it is impossible to sun-dry copra satisfactorily in this country. During the day the air is about 79 per cent saturated with moisture while at night the relative humidity average 95 per cent. Apart also from seasonal fluctuations, humid days and relatively dry days alternate irregularly so that it is impossible to work on standardized lines in order to obtain a standard product either by sun-drying alone or by kiln-assisted sun-drying. Careless preparation, therefore, becomes the rule and local dealers adjust their prices accordingly.

In Table I, certain records are given relating to the atmospheric conditions existing in an important coconut district and from these figures an approximate estimate may be made that in the most humid month it takes four times as long to sun-dry copra as during the driest month, while on certain days it will be quite impossible to effect any drying. Thus in the month of November, a piece of wet copra (moisture about 50 per cent) was exposed in the sun for five days by which time it still contained 35 per cent of water and was heavily covered by a multi-coloured mycelium of copra moulds.

To make matters still worse, there is the added factor of heavy moisture generation when such badly prepared native copra is stored under unsatisfactory conditions (see later).

Table I.

Atmospheric Conditions on the Selangor Coast (Bukit Jeram).

1929 *Mean Hourly Values for Relative Humidity (Day).*

Hours :—	..	9	10	11	12	1	2	3	4	5	6
July	..	78	74	71	68	68	67	67	69	70	74
November	..	86	81	75	74	74	75	76	79	83	88

MEAN VALUES.

	Day (10 *hours*)	*Night* (14 *hours*)	24 *hours*.
July	71	88	81
November ..	79	95	89

	Hours of strong sunshine. (*daily mean*)	*Strong windy days.*
July	8.5 hours	1 day
November ..	6.4 hours	3 days

RELATIVE DRYING POWER OF AIR (SHADE).

Assume no drying at about 80 per cent humidity.

	Day	*Night*
July	96 units	0
November ..	27 units	0 (? with moisture reabsorption).

At this stage the related question of moisture reabsorption might be considered. While it is claimed for the Philippines (1) that 5 per cent moisture represents approximately the stable moisture content in copra there, the Malayan figure depends on the time of the year and, of course on the structure of the copra. A skinned over or "case-hardened" copra will naturally take up moisture more slowly than a uniformly dried piece of copra (see later).

It has been found that during the dry season, copra can be dried to 4 per cent moisture content and will remain dry and that wetter copra will on very prolonged storage under good conditions continue to dry out to this figure. In the wet season similarly well-dried copra will, however, reabsorb moisture slowly to between 6 per cent and 7 per cent for "case-hardened" copra and even up to about 10 per cent for copra which has not a protective skin. About 6 per cent represents the average stable condition for kiln-dried copra stored in bulk. It would materially

assist the welfare of the industry and simplify the handling and marketing of this commodity if this figure were adopted as the standard by all producers.

During transport to Europe, all the copra produced in this country dries further and almost invariably on arrival at its destination the moisture content is between 4 per cent and 5 per cent.

To allow for moisture loss and possible deterioration of quality in transit, the usual practice is for the shipper to claim a weight allowance of about 5 per cent whether such a loss occurs or not.

Copra Deterioration.

A copra of satisfactory moisture content (*viz.*, 6 per cent) is liable only to the formation of a thin white mould which readily falls off in transit leaving the copra clean white on arrival in Europe. Copra of higher moisture content produces white, brown, green or heavy black moulds apparently indiscriminately with the development of heat, free acidity, rancid odour and internal darkening of the material. Black mould in particular is indicative of copra with a moisture content in excess of 10 per cent. The factors which determine the development of specific moulds are in course of determination as it is fairly certain that the moisture content is more an agent than a controlling factor.

It is specially interesting to note that the process of decomposition adds moisture to the copra so that when bad copra is stored in ill-ventilated store rooms or transported in leaky boats, the quality may easily become progressively worse and result in a hot, slimey, dark, evil-smelling, matted product of high acidity but with a high oil content (see Table III and later).

Two samples of copra were stored for two months in sealed tins with the following results :—

Description	*Original Moisture per cent*	*Final Moisture per cent*	*Description*
White, crisp ..	4.5	5.4	F.M.S. quality maintained.
White	12.1	64.7	Rank smell. Black, congealed and rotten.

While such slimey copra is of no value for export purposes, it is sold locally at a cheap price and commands a ready sale to certain Malayan oil mills. It is important to explain why such copra contains

a high percentage of oil while at the same time heavy losses are incurred during the process of deterioration, both oil and copra being converted to water vapour and gas and lost.

Oil Gradient.

When slices are cut from pieces of coconut meat parallel to the testa or brown skin and the different slices are analysed it is found that an oil gradient exists in the meat which in the case of ungerminated nuts is particularly marked. The figures in Table II serve to illustrate this point.

Table II.

Oil Gradient in Coconut Meat.

Nut Selected	Oil percentage (dry basis). Slices of equal thickness					
	1	2	3	4	5	Testa
Ripe brown nut	40.0	64.6	67.2	75.8	73.7	13.8
Ripe (1″ haustorium)	52.0	68.2	72.8	76.0	76.4	....
Over-ripe (4″ haustorium)	..	73.8	70.2	74.5	74.5	....

Table III.

Copra Deterioration.

To illustrate the relation between high free fatty acid (f.f.a.) and high oil percentage.

		Good undeteriorated copra	Insect-ridden copra	Mould and insect-ridden
Malayan Estate Copra	No. of samples	16	2	8
	Average oil percentage ..	65.8	65.4	66.8
	Average f.f.a. percentage ..	.1	.2	.8
Straits Native Copra	No. of samples	6	7	19
	Average oil percentage ..	64.8	65.2	67.0
	Average f.f.a. percentage ..	.3	1.2	1.6

Thus when moulds attack the inside face of a piece of copra, it would appear that as the tissue containing the lowest oil percentage is broken down and removed in the form of gas and water-vapour the unattacked copra that remains becomes progressively richer in oil. As deterioration progresses (in the absence of insect attack) the average oil percentage therefore increases and figures in excess of 70 per cent oil for low grade Malayan copra are quite common. Only in very exceptional cases is the percentage of oil lower than 66 per cent in mouldy Malayan copra, *i.e.*, when copra is uniformly rotten throughout.

During such deterioration free acidity, and the further destruction products of glycerol render the copra sour and evil-smelling and the resulting oil and cattle cake dark and unpalatable.

However, it is important to note that the ether extract includes the free fatty acid so that deteriorated copra does not contain as much neutral oil as analytical results expressed as oil percentage (dry basis) may appear to show. The importance of this observation lies in the fact that the purification of an extracted coconut oil to remove its free acidity yields in large quantities what is known as "dirty soap stock" and in an edible oil factory the disposal of this bye-product is difficult while in the soap factory it can only be used in low grade soaps, because it retains most of the dirt and colour of the oil. This soap stock is not of much value and its removal by caustic soda is expensive.

During deterioration by heat, moulds, or insects, there is a concealed loss of oil and copra constantly proceeding which may be very considerable. It is the producer who suffers from these causes, because the various buyers allow in the price they are able to offer for anticipated depreciation in transit.

That actual loss of oil and copra occurs during deterioration has been shown experimentally in Fiji (2) by exposing copra on a drying "Vata" to the action of air-borne moulds. In 14 days it was found that the copra dried to 5 per cent but that it lost 12.4 per cent of its anhydrous weight and 8.2 per cent of its total oil while the free acidity rose from .2 per cent to 8.5 per cent.

It has been found in Malaya that if bad copra, which has developed a high degree of rancidity, is stored under good conditions of free ventilation, the acidity diminishes while the copra as a whole will become dry and clean and the mould will fall away as dust. Six large samples were stored for three months under excellent conditions and the results are given in Table IV.

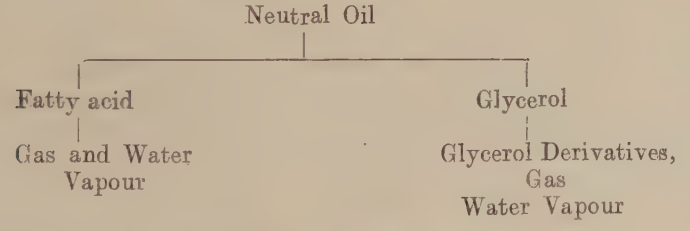
TABLE IV.

EFFECTS OF STORING NATIVE COPRA.

DATE OF RECEIPT 28–12–29.

Original Appearance			Acidity of oil per cent (as lauric acid)			Final appearance
			30–12–29	28–2–30	18–3–30	
Light brown	Mouldy	Superficial insect attack ..	.72	.42	.42	All the copra now dry and mould free but exceedingly insect ridden originally the samples looked different, now they look similar.
Light brown	Mouldy	Superficial insect attack ..	1.72	.43	.22	
Dark brown	Very mouldy	Insect-ridden ..	2.48	1.82	1.51	
Dark brown	Very mouldy	Insect-ridden ..	3.02	1.21	....	
Dark brown	Very mouldy	Insect-ridden ..	3.12	1.76	0.80	
Dark brown	Very mouldy	Insect-ridden ..	3.43	2.15	2.04	
	Average		2.42	1.30	1.12	

It would appear that the drying of the copra arrests further acid formation from the neutral oil while the existing fatty acids are converted into water vapour and gas and removed with a consequent reduction in the f.f.a. content.



PHYSICAL PROPERTIES.

Apart from its good keeping qualities, well-dried brittle copra is to be preferred because, as has been stated by an authority in England, rubbery copra does not press well. When the pressure is applied the oil flows satisfactorily, but at the end of the operation when the pressure is released, the cake tends to suck up the oil again owing to the elasticity of the material. This authority has stated that with such copra it is not possible to reduce the oil below 7 per cent whereas good friable copra yields a cake with 5 per cent oil.

Such rubbery copra may be produced from young nuts, and "case-hardened" copra with a wet core will also show elastic properties. It

is interesting to note that "case-hardened" copra appears to show considerable resistance to mould attack except in the presence of insects which are able to pierce the burnt crust and so expose the wet copra beneath to mould attack.

Size.

If the pieces of copra are too large, the consignment will naturally be very bulky, and the best practice is to chop the half nuts into four pieces. The manufacturers object to copra of large size on the grounds that it takes longer to charge the machinery and more storage room is required owing to the bulkiness of the material.

At this point some reference might be made to the advantages of the baling of chopped copra. To date, one firm in this country has exported during the past year 500 tons of "F.M.S." copra in baled form to Europe with entirely satisfactory results. An article on this subject giving the experimental results obtained has already been published and further experimental work is proceeding to explore the possibilities of the baling of the lowest grade of copra available on the Singapore market.

It should be noted (*a*) that copra can be compressed at a pressure of 1.5 cwts. per square inch without loss of oil either during compression or subsequent storage and shipment. (*b*) That the "broken stowage" is reduced, *e.g.*, 20 cwts. of baled copra occupies only the same cargo space as 12 cwts. of sacked copra. Local transport and shipping freight charges can accordingly be reduced. (*c*) The bales stack squarely leaving straight channels for air movement through the stack. (*d*) The bales, which are 2 cwts. in weight, can be easily checked and are of convenient size and shape. (*e*) There is no evidence that "F.M.S." copra deteriorates more in transit in baled form than in sacks, nor is there any loss of oil.

If the material is much broken up so that there are "smalls" the dealer objects because :—

(*a*) this allows the careless or deliberate inclusion of foreign matter (grave exception is taken to sand, nails, etc., which can do great damage to machinery).

(*b*) it makes sorting of "mixed" copra into "F.M." and "F.M.S." grades difficult ;

(*c*) much broken-up copra exposes a large surface to mould and insect attack and the smallest pieces are gradually converted to a grey fibrous dust which gives the material a dirty appearance. The small pieces are also readily lost in handling ;

(*d*) the cattle cake derived from such copra will be sour and darker than the best.

The production of "smalls" should, therefore, be avoided and it is recommended that, where the meat must be extracted wet from the shell in the field, as far as possible only fully-ripe nuts should be harvested. The meat of unripe nuts is very adherent to the shell, while the thin meat of very over-ripe nuts is inclined to break. On the other hand, where the halved nuts are transported to the kiln and are subjected to semi-drying, the half pieces of meat readily fall out of the shell. When the fully dried copra is subsequently chopped to reduce the bulk, care must be taken to obtain pieces of even size. It is doubtful, however, if this practice is to be recommended as a fresh wet surface is thereby exposed to mould attack. It would be better to chop the copra when half dry as it comes from the shell and then dry and seal the cut surfaces.

Thickness.

As far as possible, only fully ripe brown nuts should be used for the production of copra, because such nuts produce the greatest thickness of dry meat. The practice of picking unripe nuts in order to take advantage of a favourable market, or to obtain a speedier cash return or because crop collection is leased out, or to anticipate theft, is well known.

Oil Content.

It has been shewn that bad copra can contain a high percentage oil content, *i.e.*, high ether extract. At the same time the yield of neutral oil will be small and it will be of low quality on account of extraction difficulties. A large amount of soap stock has to be removed to purify the oil, while much of the original colour and odour is still retained in the oil even after refining.

The ultimate objective is to produce a copra equivalent in physical condition, appearance and oil content to the "F.M.S." Ceylon product. In Ceylon a white copra of high oil content is regularly produced, and receives special preference in the London market. The related questions of cultivation and soil impoverishment are being investigated, while correct nut harvesting and possible oil loss during copra preparation are also being studied with a view to correcting the alleged decline in the oil content of good quality Malayan copra during the last ten years.—*The Malayan Agricultural Journal*, Vol. XIX, No. 3.

THE MYSORE AGRICULTURAL AND EXPERIMENTAL UNION.

Programme of Experimental Work for 1932.

CIRCULAR.

The Department of Agriculture desires to arrange with members of the Mysore Agricultural and Experimental Union for the carrying out of the experiments mentioned below. Members intending to undertake experimental work are requested to apply to the Secretary, The Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore, before the 15th January 1932 marking out the experiment or experiments they desire to undertake on this circular itself. The seed, manure, etc., will be supplied in the order in which the application is received as long as the stock lasts.

1.—Experiments with Seeds.

Trial of selected strains of—

(*a*) Ragi—seed enough for 3 guntas each of two new varieties will be supplied.

(*b*) Groundnut—seed enough for 3 guntas each of one or two new varieties will be supplied.

(*c*) Cotton :

(1) Doddahatti—seed enough for 3 guntas will be supplied.

(2) Sannahatti—seed enough for 12 guntas each of two varieties will be supplied. (Trials confined to cotton areas only.)

(*d*) Paddy—seed enough for 3 guntas each of two varieties will be supplied.

(*e*) Sugarcane—seed enough for one gunta each of two Hebbal seedling canes will be supplied. Arrangements for the conveyance of seed setts from the nearest railway station should be made by the member indenting for them. Applications for sugarcane setts should be made so as to reach the Secretary before the 15th January 1932 stating the probable time the setts should be supplied and the Railway Station to which they should be sent.

Conditions of Supply of Seed.

1. The seed of each variety shall be sown in separate plots with check plots arranged as per instructions sent with the seed.
2. The results of experiments shall be reported after harvest in the form which will be supplied.
3. The experiments shall be conducted continuously for at least three years, seeds for the second and subsequent sowings being reserved from the first supply by the Agricultural Department.

2.—Experiments with Manures.

I. Sugarcane.—Comparative trial of 100 lbs. of ammonium sulphate and 3 cwts. of superphosphate per acre applied before planting and 240 lbs. of ammonium sulphate 6–8 weeks after planting and 1 ton of groundnut cake applied again 3 months after planting, against—

(*a*) 100 lbs. of Ammophos 13/48 grade or Nicifos 17/45 grade and 50 lbs. of ammonium sulphate before planting ; 240 lbs. of ammonium sulphate 6–8 weeks after planting and again 1 ton of groundnut cake 3 months after planting, *or*

(*b*) 100 lbs. of Ammophos 13/48 grade or Nicifos 17/45 grade and 50 lbs. of ammonium sulphate before planting ; 320 lbs. of ammonium sulphate 6–8 weeks after planting and again ½ ton of groundnut cake 3 months after planting.

II. Paddy.—Trial of 80 lbs. of sulphate of ammonia and 150 lbs. of superphosphate per acre, against—

(*a*) 60 lbs. of Ammophos 13/48 grade or Nicifos 17/45 grade + 100 lbs. of groundnut cake, *or*

(*b*) 120 lbs. of Ammophos 20/20 grade or Nicifos 22/18 grade.

Not less than 10 guntas of land will be required in each case.

3.—Areca.

Trial of a mixture of 400 lbs. groundnut cake, 100 lbs. concentrated super and 120 lbs. muriate of potash per acre of 400 bearing trees against—

(*a*) 160 lbs. sulphate of ammonia, 100 lbs. concentrated super and 120 lbs. muriate of potash, *or*

(*b*) 200 lbs. Ammophos 20/20 grade or Nicifos 22/18 grade and 120 lbs. muriate of potash, *or*

(*c*) 150 lbs. Nicifos 17/45 grade and 120 lbs. of muriate of potash.

A minimum of 180 bearing plants are required for the purpose.

The manures required for all the trials will have to be purchased by the member.

4.—Experiments on the Control of Insect Pests.

(*a*) Sugarcane Borer.
(*b*) Pests of Stored Pulses.
(*c*) Pests of Stored Paddy.
(*d*) Coffee Borer.
(*e*) Lime-tree Borer.
(*f*) Avare Pod Borer.

} Printed instructions will be sent on requisition.

5.—Experiments on the Control of Fungus Diseases.

(*a*) Treatment against Smut on Jola.

(*b*) Spraying against *alternaria* disease of potato.

BANGALORE, 5—1—1932.

LESLIE C. COLEMAN,
President,
The Mysore Agricultural and Experimental Union.

DEAR SIR,

I desire to undertake the experiments ticked off on the circular during the coming season. I have conducted the experiments undertaken by me last year properly. I agree to conduct the experiments and report results as required during the present year. Please arrange to supply the requirements.

Station.....
Date.....

Yours faithfully,

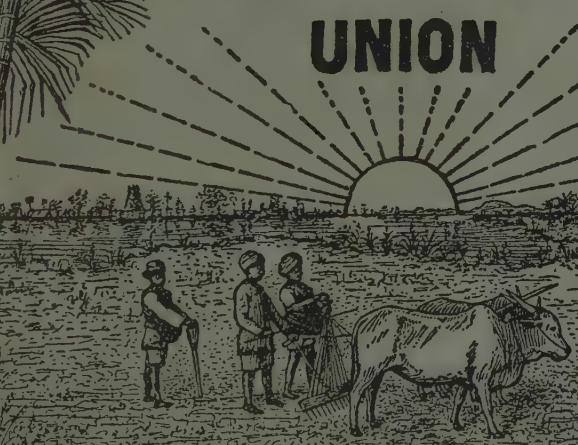
Signature and Address of the Member.

N.B.—This programme has been sent to Members seperately in time.—*Secy.*

2610-31 Printed at the Bangalore Press, Mysore Road, Bangalore City

LIBRARY
1 AUG 1931
Ag. 6

THE JOURNAL OF THE MYSORE AGRICULTURAL & EXPERIMENTAL UNION



Vol. XII] 1931 [No. 1

PRINCIPAL CONTENTS.

Agricultural Impressions of Java—Dr. Leslie C. Coleman, M.A., Ph.D.

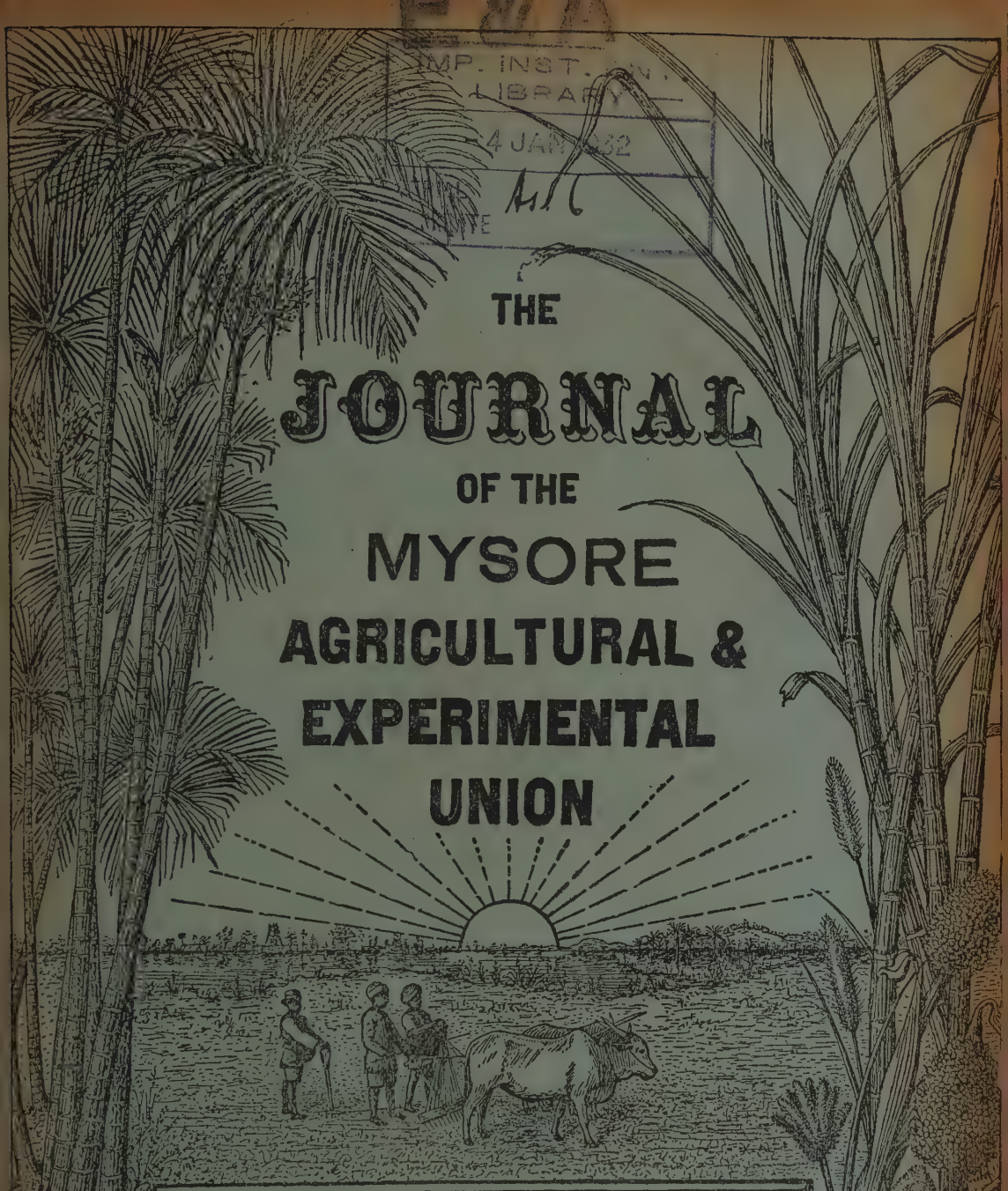
The Propagation of the Pepper Plant—A. K. Yegnanarayana Iyer, M.A., Dip. in Agri. (Cantab.), N.D.D.

CONTENTS.

	Pages
Agricultural Impressions of Java—By Dr. Leslie C. Coleman, M.A., Ph.D., Director of Agriculture in Mysore	1— 2
Ground Grubs and Their Movements in Soils—By Dr. K. Kunhi Kannan, M.A., Ph.D., Entomologist to the Government of Mysore	3— 4
Sexuality of the Koleroga Fungus—By M. J. Narasimhan, B.A., Officiating Mycologist, Department of Agriculture, Bangalore	4— 7
The Propagation of the Pepper Plant—By A. K. Yegnanarayana Iyer, M.A., Dip. in Agri. (Cantab.), N.D.D., Deputy Director of Agriculture in Mysore ..	7—17
The Worm Parasites of Domesticated Animals with Special Reference to Parasitosis in Sheep—By P. U. Nair, G.B.V.C., Assistant Superintendent, Mysore Civil Veterinary Department	18—25
SELECTIONS—	
Instructions for Making Compost—Lactating Dairy Cattle need Plenty of Water—Arabian Coffee—Soil Surveys and their Utilization—Rice: Cultivation and Treatment	26—55
Prohibition of Import of Unroasted Coffee Beans—Notification of the Government of India, Department of Education, Health and Lands, Simla ..	56

IMP. INST. OF AGRIC.
LIBRARY
14 JAN 1932

THE JOURNAL OF THE MYSORE AGRICULTURAL & EXPERIMENTAL UNION



Vol. XII] 1931 [No. 2

PRINCIPAL CONTENTS.

The Mass Rearing of the Egg Parasites of the Sugarcane Moth Borer in Mysore—By K. Kunhi Kannan, M.A., Ph.D.

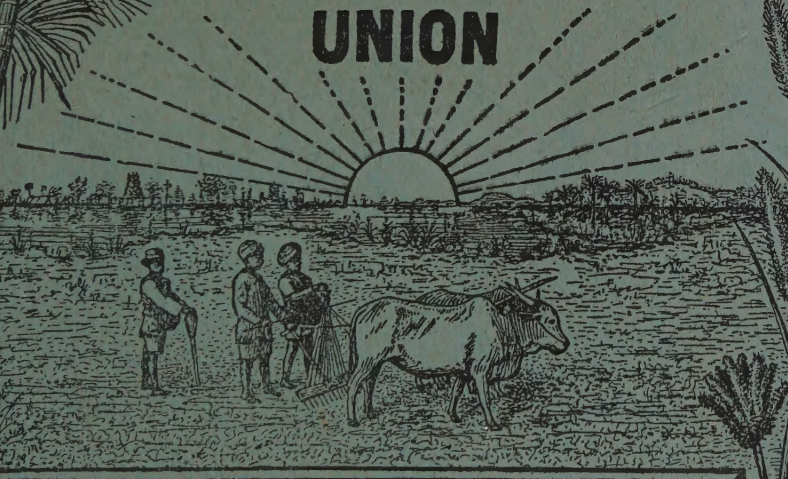
Report on Cinchona Cultivation in Java—By Leslie C. Coleman, C.I.E., M.A., Ph.D.

CONTENTS.

	Pages
The Mass Rearing of the Egg Parasites of the Sugarcane Moth Borer in Mysore—By K. Kunhi Kannan, M.A., Ph.D., Entomologist, Department of Agriculture ..	57— 61
Thirteenth Annual Meeting of the Mysore Agricultural and Experimental Union, 1931—	
President's Speech—By Leslie C. Coleman, C.I.E., M.A., Ph.D.	61— 68
Annual Report	69— 74
Opening Speech—By Rajakaryapravina P. G. D'Souza, B.A., B.L.	75— 80
Report on Cinchona Cultivation in Java—By Leslie C. Coleman, C.I.E., M.A., Ph.D., Director of Agriculture in Mysore	81— 88
SELECTIONS—	
Milk Fever or Dropping after Calving in Cows—Prohibition of Import of Diseased Rubber and Coffee—Feeding and Care of the Dry Cow—Irrigation of Citrus Trees—Soil Management—Mineral Salts and Animal Nutrition—The Biology of Seeds	89—112

IMP. INST. ENT.
— LIBRARY —
15 FEB 1932
SERIAL
ACCESSION

THE JOURNAL OF THE MYSORE AGRICULTURAL & EXPERIMENTAL UNION



Vol. XII] 1931 [No. 3

PRINCIPAL CONTENTS.

Notes on Sugarcane Cultivation in Java—By Leslie C. Coleman, C.I.E., M.A., Ph.D.

Factors influencing Root Development in Rice and some Consequences.

CONTENTS.

Pages

Notes on Sugarcane Cultivation in Java—By Leslie C. Coleman, C.I.E., M.A., Ph.D. .. .. 113—144

NOTES AND COMMENTS—

Notes on Sugarcane Cultivation in Java .. .. 145—146

SELECTIONS—

Award of Prizes and Medals for Improvements in Agriculture and Animal Husbandry—Some Principles Useful in Solving Economic Biological Problems—Factors influencing Root Development in Rice and some Consequences .. .. 147—168

EXD
LIBRARY
14 MAR 1932
As. 6

THE JOURNAL OF THE MYSORE AGRICULTURAL & EXPERIMENTAL UNION

Vol. XII] 1931 [No. 4

PRINCIPAL CONTENTS.

Co-operative Cotton Sale Societies in Dharwar, Bombay Presidency—By A. K. Yegnanarayana Iyer, M.A., Dip. in Agri. (Cantab.), N.D.D.

Factors of Quality in Copra.

CONTENTS.

	Pages
In Memoriam—Dr. K. Kunhi Kannan, M.A., Ph.D. ..	169—173
Co-operative Cotton Sale Societies in Dharwar, Bombay Presidency—By A. K. Yegnanarayana Iyer, M.A., Dip. in Agri. (Cantab.), N.D.D.	173—192
The Place of Science in the Development of Mysore Agriculture—By Leslie C. Coleman, C.I.E., M.A., Ph.D.	193—204
SELECTIONS—	
New Rice Research in India—Nitrogen in Farm Manure—Habits and Control of the Coconut Black Beetle (*Oryctes rhinoceros*, L.)—Russian-Grown Tea—Preparation of Vinegar from Coffee Fruit Pulp—World Cures for the World's Economic Ills—An International Enquiry on the Biological and Artificial Control Measures of Nut Grass (*Cyperus rotundus*)—Factors of Quality in Copra ..	205—220
Programme of experimental work for 1932 ..	221—223